



National
Defence

Défense
nationale

Maritime Engineering Journal

Canada's Naval Technical Forum



Since 1982

Spring 2019

Special Feature:

Autonomous Underwater Vehicles —
Untapped Operational Capability



Canada

75th ANNIVERSARY

Saluting units of the Royal Canadian Navy and all Allied forces that took part in the D-Day landings

June 6, 1944



Photo courtesy Parks Canada: ON-HAI-Historical Images-2003-07-15(74)

The Tribal-class destroyer *HMCS Haida* (G63) was one of 109 RCN vessels that supported the successful Allied landings in Normandy, which led to eventual victory in the Second World War. The ship has been preserved as a National Historic Site under the aegis of Parks Canada, and is berthed on the Hamilton, Ontario waterfront. The floating memorial is open to the public under her final hull pennant number of 215.

Details can be obtained at: www.pc.gc.ca/en/lhn-nhs/on/haida.

A brief history of *Haida* and an account of the latest restoration efforts to preserve the ship's steel structures can be found in CNTHA News on page 24....



**Director General
Maritime Equipment Program
Management**

Commodore
Christopher Earl, CD

Senior Editor
Capt(N) Mark Sheppard
Chief of Staff MEPM

NCM Editorial Advisor
CPO1 Gerald Doutre
DGMEPM Unit Chief

Project Manager
Lt(N) Shane Kavanagh

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

Maritime Engineering Journal



(Established 1982)
Spring 2019

Commodore's Corner

Rewarding career paths in the RCN's Naval Technical branch by <i>Commodore Christopher Earl, CD</i>	2
Maritime Engineering Journal Readership Survey 2019	4

Forum

Learning from Failure by <i>A/Slt Courtney Bornholdt</i>	5
---	---

Feature Articles

Autonomous Underwater Vehicles – Untapped Operational Capability by <i>Lt (N) Parth Pasnani and Dr. Mae L. Seto</i>	8
Recognized Organizations: A Strategic Step Forward in Naval Materiel Assurance by <i>Capt(N) Jacques Olivier and Cameron MacDonald</i>	13
Aquatic Invasive Species – A Freshwater Ballasting Solution for the RCN by <i>Douglas Green</i>	16

Book Reviews

<i>Weapons of Desperation</i> reviewed by <i>Tom Douglas</i>	21
<i>No-Badge Killick</i> reviewed by <i>Brian McCullough</i>	21

News Briefs

RCN Chief Engineers	22
Launch of the future HMCS <i>Harry DeWolf</i>	22
Awards	23

CNTHA News

Preserving the RCN's ceremonial flagship – HMCS <i>Haida</i> by <i>Alan Lenarduzzi</i>	24
---	----



One of the RCN's new Remus 100 autonomous underwater vehicles undergoing trials off Norway from HMCS *Glace Bay*.

(Photo courtesy Joe Podrebarac)

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. Unless otherwise stated, *Journal* articles may be reprinted with proper credit. A courtesy copy of the reprinted article would be appreciated.



COMMODORE'S CORNER

Rewarding career paths in the RCN's Naval Technical branch

By Commodore Christopher Earl, CD

Late last summer, with the simple turn of a page, I completed 32 years of service in the Royal Canadian Navy. There have been many stages and points in my career that have left vivid memories and, now that I think back, most are positive, and I truly hope that your career recollections are similar. It is human nature to imagine that our own hectic work lives must be more complex and demanding than anything our predecessors had to deal with, but I have to admit that the fast, furious, and sometimes frenetic tempo of our current fleet maintenance and renewal activity is more than enough to keep everyone in the Naval Technical branch fully engaged and gainfully employed these days. We might feel a bit overwhelmed at times, but I can assure you that as a community we are hitting it out of the park on every level.

As I mentioned in my last Commodore's Corner, I firmly believe that naval technical work is all about maintaining momentum and pace. When you step back and think about the extraordinary employment opportunities that are offered to us, there really is something for everyone. Whether it is service in ships, submarines, fleet maintenance facilities, procurement, project management, general support, or even along non-traditional lines such as in intelligence or within the Naval Tactical Operations Group, the possibilities are almost endless. Emerging areas in cyber defence, additive manufacturing, and a new hybrid model for fleet maintenance are offering exciting opportunities on the cutting-edge of technology and in evolving ways of thinking. Wherever your interests lie, there is almost certainly a challenging and rewarding career path for you within the RCN's Naval Technical branch.

I understand that having such a wide range of options available can seem daunting when it comes to looking at career aspirations and employment, but we have a strong culture of both professional and informal mentoring in our branch that offers each one of us something hugely positive. The conversation that goes on between and among sailors and officers creates healthy work relation-



Photo Credit: PO1 Bayla Ross-Blevins, HMCS ONTARIO Public Affairs.

The Royal Canadian Sea Cadets graduating from their 2018 summer training programs last August at the HMCS ONTARIO Cadet Summer Training Centre in Kingston might or might not go on to find careers in the RCN's Naval Technical branch, but they certainly enjoyed the Bravo Zulu they received for all of their hard work over the summer from reviewing officer, Commodore Christopher Earl, CD, Director General Maritime Equipment Program Management.

ships, maintains open lines of communication, and ensures valuable knowledge-transfer throughout the entire community. The dialogue through this interaction often includes some hard talk on difficult issues, but such an open and transparent narrative is necessary if we are to trust one another, learn from one another, and find a career path that suits us.

While everyone's experience is different in its own way, it is important to remember that the scope of most jobs can be shaped and tailored by the individual in the chair. Letting my passion for submarine operations guide my own career certainly had its ups and downs (pun intended), but on the whole I was able to make choices that worked out well for me. There continue to be times when I feel

"Wherever your interests lie, there is almost certainly a challenging and rewarding career path for you within the RCN's Naval Technical branch."

completely overwhelmed and busy beyond belief, but I can honestly say that it has been the most demanding undertakings that have given me the greatest sense of pride and accomplishment. It's the hard slogs that seem to return the most satisfaction.

There will always be some degree of commitment and hardship in the mix when we set out to achieve important things in our business. Whether this is associated with a tour at sea as Head or Chief of Department, a position of

responsibility in fleet engineering, or a desk in Ottawa to support an important project in fleet renewal, I can assure you that the challenging postings will indeed be your most memorable, and usually for the best reasons. The toughest jobs, done well, not only fill us with a sense of accomplishment like nothing else can, but they also give us those great stories — the salty "dits" we all love to tell and retell. As with anything in life, it is often the most difficult tasks that are the most rewarding, and I would encourage each and every one of you to proactively seek these opportunities within the Naval Technical community, as they will indeed enrich whichever employment path you ultimately choose.



Maritime Engineering Journal Readership Survey 2019

Your opinion of what we produce within the pages of the *Maritime Engineering Journal* is vitally important in helping us ensure we continue to deliver the best naval branch technical publication possible. It's been years since we conducted our last survey, so we thought it was time to take the pulse of our readership again.

The process today is much easier than in the past, of course, so until June 30, we ask that you please go online at <https://www.surveymonkey.com/r/H73NQJ5> to let us know how we are doing. Your responses will guide us in our efforts to keep the Journal relevant and interesting to the Royal Canadian Navy's diverse naval technical community, and to others around the world who are interested in who we are and what we do to support the technical needs of Canada's naval fleet.

These are the questions you will find online. Thank you for telling us how we are doing.

Q1: Please identify yourself using the checkboxes below:

- Canadian Armed Forces – Officer (Regular Force)
- Canadian Armed Forces – Non-Commissioned Member (Regular Force)
- Canadian Armed Forces – Officer (Primary Reserve)
- Canadian Armed Forces – Non-Commissioned Member (P Reserve)
- Canadian Armed Forces – Retired
- Civilian Employee: Department of National Defence – Engineer
- Civilian Employee: Department of National Defence – Technician
- Civilian Employee: Department of National Defence – Retired
- Civilian: Non-Government
- Member of Non-Canadian Military

Q2: Overall, the MEJ meets a standard with which I am satisfied:

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree
- Please feel free to provide additional comments:

Q3: The MEJ's print format and page layout are effective:

Same response choices for Questions 2-8.

Q4: The amount of technical content within the MEJ is satisfactory:

Q5: The technical content within the MEJ is interesting and appropriate:

Q6: The non-technical content within the MEJ is interesting and appropriate:

Q7: The content within the MEJ focusing on personnel is interesting and appropriate:

Q8: The length of the articles found within the MEJ is generally:

- Too short
- About the right length
- Too long
- Please feel free to provide additional comments:

Q9: Please indicate which of the following publication formats you are interested in:

- Paper copy
- Electronic via Email
- Electronic via Webpage
- Electronic via Mobile Application
- Please feel free to provide additional comments:

Q10: Are there any additional comments you would like the editorial staff of the MEJ to consider?



FORUM

Learning from Failure – User Interface Design in the Royal Canadian Navy

By A/Slt Courtney Bornholdt

As a junior Naval Combat Systems Engineering officer, I recently finished my Naval Engineering Indoctrination course. The first thing we learned in our course is that the Royal Canadian Navy (RCN) as we know it today was shaped by failure. The 1969 HMCS *Kootenay* fire prompted us to start monitoring the temperature of the main gearboxes and replace aluminum ladders in machinery spaces. The fire on board HMCS *Chicoutimi* in 2004 taught us the importance of proper inspections and refits of our equipment acquisitions, and updated our fire safety procedures. And we didn't just learn from our own failures; we pay attention to the failures of our allies, and implement their lessons learned wherever possible. For example, the RMS *Titanic* sinking taught us the importance of having watertight bulkheads through all decks, and the USS *Vincennes* incident prompted us to change our procedures to improve communication throughout the ship and provide more realistic training to our sailors. These are just some of the many examples of how the Royal Canadian Navy has taken advantage of failures, allowing us to improve our ships, our weapons, our processes, and our training over the years.

However, as we move forward, we must consider another important aspect of our modern naval fleet — software. Whether we like it or not, software is the future of warfare. Where in previous decades our ships were operated mechanically and by hand, with each successive year software is controlling more and more of our equipment, shaping the way we operate both at sea and ashore. Software can mean the difference between being destroyed by an enemy and living to fight another day, because a computer can assess risks and calculate a fire-control solution far faster and more accurately than even our quickest operators. So now, to keep up with the pace of navies around the world and remain a formidable fighting force, it is time for us to learn from software failures. In particular, I want to focus on failures in software user interface (UI) design: the screens, menus, buttons, etc., that we humans use to interact with a program.



Figure 1. Screenshots of missile alert messages received on an iPhone during the Hawaiian ballistic missile alert crisis of January 13, 2018.

Source: <https://www.theguardian.com/technology/2018/jan/15/hawaii-missile-false-alarm-design-user-interface>

Case Study: The Hawaiian Ballistic Missile Alert Crisis

On January 13, 2018, amid the height of North Korean missile testing and tensions with the United States, a ballistic missile threat alert (Figure 1) was sent to every person in the State of Hawaii. Believing they were just minutes from their deaths, people were sending messages to loved ones and desperately seeking whatever shelter they could find. It wasn't until 38 minutes later that a correction was sent out; the alert was a mistake, there was no missile headed for the islands, and they were all going to be safe.

People were relieved, but traumatized and upset from the ordeal. As you might expect, everyone was furious and demanded to know how this could have happened. An investigation showed that an operator conducting a routine drill to test the system had accidentally selected the option to send a real alert rather than a drill notice. Many quickly blamed the operator for the mistake and called for the person to be fired.

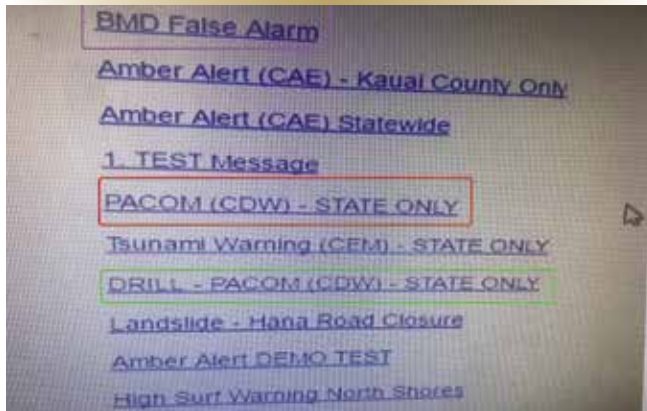


Figure 2. This poorly designed options menu contributed to an unintentional ballistic missile alert being issued for the State of Hawaii.

The screenshot in Figure 2 shows what operators of the alert system would see in their day-to-day work. The green box highlights the option that was meant to be selected; the red box shows what was actually selected; and the pink box shows the false alarm option that could have allowed the mistake to be corrected. Here, we see a number of UI design flaws that led to the crisis. First, the various options were inconsistently named, and only a single word separated actual alerts from routine drills. The options were inconsistently ordered, making it more difficult to logically separate the options. Drills, alerts, and false alarm notifications were all grouped together, meaning that there was no separation in any way between routine actions and emergency or harmful actions.

After selecting the wrong option, the operator was presented with a confirmation box. In theory, the operator would have realized the mistake and selected “cancel.” However, confirmation boxes are such a part of our everyday lives that we are all guilty of selecting “confirm” without reading what we are confirming. Even after the alert was sent out, the user interface continued to fail the operator. In order to send a false alarm notification, the operator needed to receive special permissions from higher government officials, leading to the 38-minute delay that caused such a traumatic event in the lives of Hawaiian citizens.

This software failure highlights a major tenet of UI design that we must learn from and apply to the RCN: **Properly designed user interfaces should not allow anyone to accidentally cause harm.**

Accidental Harm in the RCN

You might be wondering how we can learn from this failure. The truth is that the NTP (network time protocol) time server, an integral part of an RCN frigate’s CMS-330 Combat Management System, suffers from this same design flaw.

Figure 3 shows the screens displayed to operators when they perform the routine action of shutting down the server, typically done when coming into home port to save power. The operator must press 2 to shut down the server, or press 3 to revert the system to factory default settings. The second photo shows the confirmation screen shown to the operator after they select either 2 or 3.

Here, we see similar issues to the Hawaiian missile alert crisis. The button for the routine option, Shutdown, is directly next to a harmful option, Factory Default. The buttons are very small, making it easy for an operator to accidentally choose the wrong button. The confirmation screen does not actually tell the operator which option they selected; meaning that if the operator selected the factory reset option, they would still think they had selected a shutdown and would confirm their selection.

This isn’t just a theoretical scenario. When I went aboard one of the *Halifax*-class frigates to take photos of the equipment, I was surprised to learn that this exact failure had in fact occurred a few months earlier. Having to reconfigure the time servers might seem like a minor inconvenience, but having the CMS unavailable while the servers are being reconfigured could cause problems in an emergency scenario. It also introduces the potential for a technician to configure them incorrectly and cause future issues in the system.



Figure 3. The network time server displays on board an RCN frigate.

This event may seem like a simple accident, but a closer inspection into the design of the interface shows that it was entirely preventable. Placing the factory default reset option on a button that is physically removed from the shutdown option (for example, button 7) and showing a meaningful confirmation message would reasonably prevent an operator from accidentally causing harm to the ship.

Working toward the Future

This is just one of many cases where our equipment has UI design flaws that could cause undue harm or burden to the RCN. While it will be a long road to changing the culture surrounding software in the Navy, there are things we can all do as members of the naval technical community to combat this issue. Regardless of where you are in your career progression, you can educate yourself on the basics of user interface design. Often, issues like the one above are neglected because we simply do not have the knowledge to recognize that the problem is one of bad design, not of operator carelessness.

Depending on our role in the community, there are also other things that we can do to shift our culture and understanding around UI design. As technology users, we can be vigilant in watching out for design flaws. When we encounter issues, we can push them up the chain and submit Unsatisfactory Condition Reports; after all, those who have the power to make changes for the better can only start the process if they are made aware. Additionally, when you encounter an issue that may impact our mission or the safety of our sailors, you can warn others around you to ensure that special care is given when interacting with that piece of equipment.

As engineers or project managers, there are a number of things we can do to help create better user interfaces for naval equipment. First, we can develop clear and thorough usage examples to help software developers design better interfaces. Second, we can make UI design a priority in the acquisition process by pushing for comprehensive, multi-stage expert user acceptance testing to help identify weaknesses before equipment reaches the fleet, and a feedback loop for updates should issues arise after acceptance. We should actively engage UI experts and experienced interface users in all stages of engineering to ensure that we consider UI design throughout the entirety of a project.

And finally, we can be conscious of our own biases. When we are heavily involved in the design of a system, we are far more likely to think that the user interface is intuitive because we know everything that the system is supposed to do. Routine operators coming from a variety of backgrounds that can influence how they understand and interact with software are unlikely to know as much about the system.

Changing the culture around user interface design in the RCN won't be easy. It will take a lot of time and a lot of work by members of the naval technical community, but we need to start now. Software is the future of warfare, and user interface design is an incredibly important part of the software aboard HMC ships. It isn't just about colours and fonts; it's about accomplishing our mission.



A/Slt Courtney Bornholdt, from New Germany, NS, is currently in training as a Naval Combat Systems Engineering Officer at Naval Fleet School (Pacific). She received her Bachelor of Computer Engineering at RMC in 2016 and recently completed her Master of Science focusing in Software Engineering from the University of Victoria in Fall 2018.

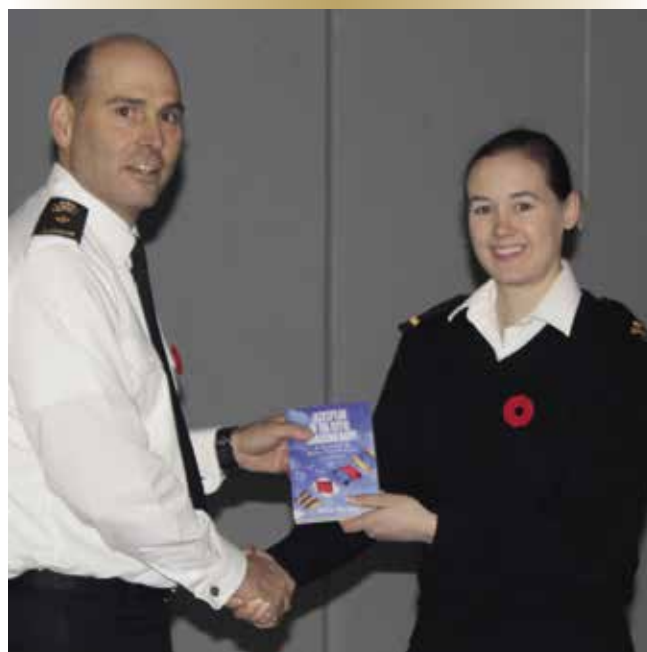


Photo by Brian McCullough

The author (right) received a book prize from Cmdre Chris Earl for best junior officer presentation at the MARPAC NT Seminar last November.

FEATURE ARTICLE

Autonomous Underwater Vehicles – Untapped Operational Capability

By Lt (N) Parth Pasnani and Dr. Mae L. Seto



Autonomous underwater vehicles such as the Alseamar SeaExplorer Glider being used by the Department of Fisheries and Oceans Canada at the Bedford Institute of Oceanography to conduct oceanographic surveys off the coast of Nova Scotia hold potential untapped operational capability for the RCN.

Recent advances in marine robotics offer transformational underwater capabilities that the Royal Canadian Navy (RCN) would do well to consider. Missions previously requiring the deployment of dedicated ships might today be better performed, in part, by autonomous underwater vehicles (AUVs) at a potentially lower cost.

AUVs are free-swimming, self-propelled, unmanned undersea marine robots that carry their own power on board, and are capable of autonomously conducting submerged operations. They can be deployed from ships, rigid-hulled inflatable boats (RHIBs), and even from jetties. Initially appearing in the 1970s, they are an emerging class of unmanned systems. In 2003, the US Navy deployed AUVs during Operation Iraqi Freedom to detect mines in the Persian Gulf harbour of Umm Qasr – the first time an AUV was deployed in an operational environment.

Over the last decade, the RCN has maintained a technology watch and observed the AUV's growing sophistication. Most navies of the world are considering – or actively using – AUVs at their advanced technology readiness level. The RCN recently acquired its first AUVs [REMUS 100s] through the Maritime Operations Group's Fleet Diving Unit (Atlantic) – see front cover. Prior to that, the RCN teamed with government agencies such as Defence Research and Development Canada (DRDC) to increase their knowledge and inform their decisions on unmanned systems.

Military Missions

A common turn of phrase for evaluating a robot is to consider whether the task is *dull*, *dirty* or *dangerous*. While this also applies to AUVs, their added value is in their ability to extend the reach and persistence of the host ship.

For example, compared to a human diver, the AUV can be on task for much longer and operate at a greater range from the ship. In a report on AUV requirements for the Committee on Armed Services of the United States Senate, the US Navy envisioned a set of nine mission spaces to which the AUV could contribute:

- Intelligence, Surveillance and Reconnaissance (ISR)
- Mine Countermeasures (MCM)
- Anti-Submarine Warfare (ASW)
- Inspection/Identification (ID)
- Oceanography
- Communications/Navigation Network Node
- Payload Delivery
- Time Critical Strike (TCS)
- Barrier Patrol for Homeland Defense and Force Protection
- Sea Base Support

The type of AUV tasked to a mission space is driven by the mission requirements. The report breaks down these capabilities into four core characteristics that cut across all the above missions: *Endurance, Sensors/Payloads, Autonomy, and Command, Control and Communications.*

Traditional AUVs

The most notable distinctions in AUV types are in their capabilities. AUVs equipped with multiple thrusters can hover (Figure 1). Those with propellers, a drive train and control surfaces must be underway to maintain the vehicle's depth/altitude and attitude. Their endurance is directly correlated to their size. It stands to reason that the more batteries they carry, the longer and faster they can go – with their sprint speeds reaching a maximum of five knots. A notable example is the ISE Ltd. Explorer AUV (Figure 2) that was deployed under Canadian Arctic ice to perform bathymetric surveys. It had an endurance of hundreds of kilometres (10 days of in-water operation) and collected data towards Canada's United Nations Convention on the Law of the Sea (UNCLOS) claim.

A naval mine countermeasures (NMCM) AUV allows its support ship to remain at a safe stand-off while the AUV conducts its survey mission for mine-like objects. The Kongsberg REMUS 100 and REMUS 600 (Figure 3) AUVs are common examples. Once deployed, they carry



Figure 1. CSIRO Starbug reef-inspection vehicle.
Wikimedia Creative Commons



Figure 2. ISE Ltd. Explorer



Figure 3. USN Remus mine countermeasures AUV

out survey missions using such devices as high-resolution side-scan sonar or multi-beam echo sounders. They have an endurance capability of 12 hours at a typical speed of three knots – providing a range of 39 nautical miles.

The Knifefish AUV (General Dynamics, Figure 4) is a similar AUV, with an endurance of 13 hours. The US Navy recently completed sea acceptance trials of the Knifefish AUV, with the next steps being developmental tests and operational assessments.

Underwater Gliders

These AUVs use a buoyancy propulsion drive to carry out missions. By using small changes in buoyancy to move up and down in the water column while moving forward (sawtooth trajectory in the vertical plane) very little energy is required for forward propulsion – which tends to be the bulk of what the power is applied to, with typical speeds of



Figure 4. General Dynamics Knifefish



Figure 5. Slocum Glider from Teledyne Marine Webb

about 0.7 knots. Consequently, gliders can use their power on what are considered secondary systems (sensors) on other AUVs. Depending on the payload sensor, the endurance can vary from weeks to months.

The Slocum Glider from Teledyne Marine Webb (Figure 5), capable of operating at a 1000-metre depth, is used by Dalhousie University's Ocean Tracking Network to collect real-time oceanographic data, and by Memorial University of Newfoundland and Labrador in profiling icebergs.

The Liquid Robotics Wave Glider (Figure 6) is tethered to a positively buoyant surfboard, which gives the glider an above-water expression. This means the higher above-water communication rates and positioning can be used for the payload sensor down below. As well, solar panels on the surfboard constantly charge batteries for secondary systems.

The Liberdade gliders developed by the US Navy's Office of Naval Research (Figure 7) uses a large wing to optimize hydrodynamic efficiency and provide space for energy storage and the payload. Conceived as part of the US Navy's Persistent Littoral Undersea Surveillance Network (PlusNet), they are large underwater gliders capable of monitoring over 1000 km of ocean with passive acoustic sensor systems. Originally intended to track diesel electric submarines in littoral waters, they were recently tasked to perform marine mammal detection and tracking.

The six AUVs highlighted here are a mere handful of the 255 devices of this nature that currently exist. Figure 8 shows a snippet of the imagery collected by an AUV integrated with a side scan sonar payload sensor. Such AUVs can be used to look for objects on the seabed.

Underwater gliders are suited to persistent, long-range and long-duration missions such as collecting oceanographic data, profiling icebergs, or conducting acoustic surveillance. Their propulsion system has a low acoustic signature which makes them difficult to detect with passive acoustic sensors and allows them to remain covert.

Looking to the future, investments are being made by the US Navy in long-range AUVs under the Extra Large Unmanned Undersea Vehicle (XLUUV) program. Lockheed Martin's Orca and Boeing's Echo Voyager AUVs (not

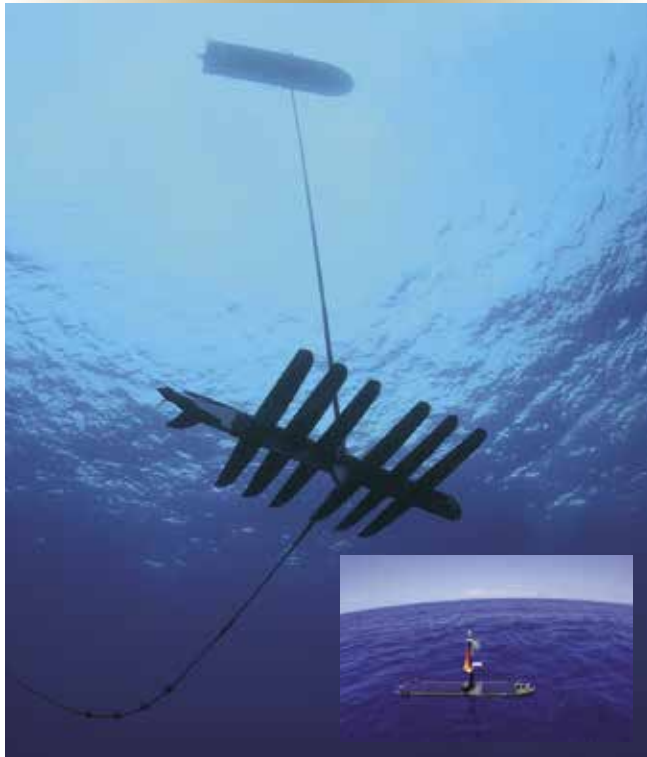


Figure 6. Liquid Robotics Wave Glider

shown) are considered to be primary contenders for this program – with the key capability being autonomous operation for months at a time.

Extended duration operations at great ranges from a ship or operator are achieved by developing the autonomy on board the AUV. This autonomy allows the UUV to make decisions, re-plan missions, collaborate with other systems (mobile or not), process *in situ* sensor measurements and re-plan a mission based on the measurements, remedy vehicle faults, adapt to the ocean environment, navigate under-ice, communicate despite poor acoustic propagation, dock autonomously underwater, and so forth. These undertakings are enabled by decision-making frameworks, advanced control architectures, mission planners, optimization tools, and machine learning and other artificial intelligence tools. Autonomy realizes the value for deploying a robot, and makes the potential value of maritime robotics a reality. With an active research group at Dalhousie University working on this, AUV autonomy is an emerging area that bears monitoring.



Figure 7. Liberdade glider



Figure 8. Side scan sonar imagery from an AUV

Other AUV Possibilities

Small AUVs are in their early stages of development, but hold potential for future applications. An analysis sponsored by the US Coast Guard was conducted on hull-cleaning robots. The report concluded that the industry was still in its infancy, with only six of the 16 robots studied being in actual use. The robots' performance outside a controlled laboratory environment was unclear. Ultimately, the cost savings in fuel due to the reduced hull drag was not a priority. Despite that, developments in this field would be well worth monitoring.

The Cognitive Autonomous Diving Buddy (CADDY) a diver-assist robot, is a research prototype at the University of Zagreb. During validation trials, CADDY guided the diver through a lawnmower pattern for a search and rescue

scenario. This eliminated the need to lay down rope on the seabed. These robots could also potentially aid a diver by delivering tools, providing illumination, taking photographs, and so on. While these robots are at a lower technology readiness level, their future applications merit careful consideration.

Conclusion

Developments in marine robotics have accelerated in the last decade. Marine robots like AUVs are sensor platforms that confer much greater persistence and reach for the ship, and as such would allow the RCN to accomplish its missions more effectively and possibly more economically. The developments in onboard autonomy will only increase that persistence and reach, so keeping a watching brief on developments is highly advisable even if no further investments are made at the present time.

References

1. Introduction to Autonomy for Marine Robots – Marine Robot Autonomy – Mae L. Seto, L. Paull, and S. Saeedi.
2. <https://news.usni.org/wp-content/uploads/2016/03/18Feb16-Report-to-Congress-Autonomous-Undersea-Vehicle-Requirement-for-2025.pdf#viewer.action=download>
3. <https://www.navy.mil/navydata/technology/UUVmp.pdf>
4. <http://www.teledynemarine.com/autonomous-underwater-gliders/>
5. Glider-based Passive Acoustic Monitoring Techniques in the Southern California Region – 2012 – Office of Naval Research – Hildebrand, John A.
6. Remus 100 AUV Brochure – Kongsberg.
7. US Navy's new Knifefish MCM AUV Completes sea acceptance testing - Naval Technology Article – 5 June 2018 (<https://www.naval-technology.com/news/us-navys-new-knifefish-mcm-AUV-completes-sea-acceptance-testing/>).
8. Analyzing the Current Market of Hull Cleaning Robots – Andrew Curran, Brendan O'Connor, Carolyn Lowe, Evan King – 14 Dec 2016 – Worcester Polytechnic Institute.
9. CADDY Project, Year 3: The Ginal Validation Trials – 2017 – Nikola Miškovic', Antonio Pascoal.



Lt(N) Parth Pasnani is the Assistant Combat Systems Engineer aboard HMCS Fredericton. He is also pursuing a Master of Applied Science degree in Electrical and Computer Engineering from Dalhousie University. Lt(N) Pasnani's thesis topic is in underwater AUV navigation. He recently presented a peer-reviewed conference paper at the IFAC Control Applications Conference in Marine Systems, Robotics and Vehicles. Lt(N) Pasnani's thesis advisor is Dr. Mae L. Seto.

Dr. Seto was a Senior Defence Scientist at DRDC for 16 years, performing research and development in autonomous systems. She is currently at Dalhousie University as an Associate Professor of Engineering, Director of the Intelligent Systems Laboratory and the Irving Shipbuilding Research Chair in Marine Engineering and Autonomous Systems. Dr. Seto is also an autonomous systems consultant to the Naval Engineering Test Establishment at the Canadian Forces Maritime Warfare Centre in Halifax.

Submissions to the *Journal*

The *Journal* welcomes **unclassified submissions** in English or French. To avoid duplication of effort and ensure suitability of subject matter, contributors are asked to first contact the production editor. Contact information may be found on page 1. Letters are always welcome, but only signed correspondence will be considered for publication.

FEATURE ARTICLE

Recognized Organizations: A Strategic Step Forward in Naval Materiel Assurance

By Capt(N) Jacques Olivier and Cameron MacDonald

A significant milestone in the Royal Canadian Navy's (RCN) strategic objective to "Improve the Delivery of Materiel Sustainability for the RCN Fleet"¹ was recently achieved with the granting of Recognized Organization (RO) status to two classification societies by the Naval Materiel Regulatory Authority (NMRA)². Lloyd's Register (LR) and the American Bureau of Shipping (ABS) received RO status in November 2018 and January 2019, respectively. LR is authorized as an RO to undertake combatant ship³ certification activities in key hazard areas of the Naval Ship Code (NSC)⁴ for the *Halifax* class and the future Canadian Surface Combatant vessels. ABS is authorized to undertake certification activities for RCN non-combatant ships⁵ in key hazard areas of the NSC. The NSC key hazard areas are described at Figure 1. The delegation of classification societies as Recognized Organizations is a best practice also leveraged by Canada's allies, including the Royal Navy and the Royal Netherlands Navy, to name a couple.

The RO designation for RCN ships is described in NATO publication ANEP 774. Within the Canadian context, it is an authorization to an independent third-party⁶ organization to support naval materiel assurance activities, including undertaking and reporting on surveys, assessing and recommending equivalencies to standards, and reporting on the quality of procedures in place (with evidence that they are being followed). RO status is granted by the NMRA after verifying the suitability and competency of the organization to execute assigned duties with respect to the NSC key hazard areas and associated standards for each class.

Naval Ship Code – Key Hazard Areas

- Structures
- Stability, Manoeuvrability, Controllability
- Engineering Systems
- Seamanship
- Fire Safety
- Escape, Evacuation and Rescue
- Communications
- Navigation
- Dangerous Goods

Figure 1. Key Hazard Areas of the Naval Ship Code

RO activities enhance certain processes already established within the Maritime Equipment Program Management division and the RCN, and provide assurances that RCN ships, throughout life, will achieve and continue to meet the requirements of relevant DND selected standards and classification society rules appropriate for the function of the vessel. The assurances are provided through the application of the classification process (Figure 2) from initial design, through construction phases, and into service. For in-service ships, the ROs conduct surveys and inspect a representative sample of maintenance, repairs, job instructions, engineering changes, and trials, collecting evidence that standards are being maintained. Effectively, ROs provide an independent verification to the collective ability of the RCN and ADM (Materiel) to confirm that surface combatant and non-combatant vessels are fit for purpose, safe to operate, and environmentally compliant while preserving the primacy of RCN operations.

1. RCN Strategic Plan http://navy-marine.forces.gc.ca/assets/NAVY_Internet/docs/en/analysis/rcn_strategicplan_2017-2022_en-s.pdf

2. NMRA — The designated person accountable to the Naval Materiel Authority for materiel safety regulation of ships. The NMRA is responsible for establishing and maintaining a materiel safety and certification framework, and providing assurances of compliance. The NMRA is independent of Design Authorities and Operational Authorities.

3. RCN combatant ship — a vessel armed with offensive weaponry with sufficient recoverability and survivability to sustain a defined level of weapons-effect damage appropriate for its mission with a crew size of 60 or more persons.

4. Naval Ship Code — a goal-based standard that determines a minimum level of safety for naval vessels. It is the formal document published by NATO (as ANEP77) which includes the Code and supporting guide. <http://www.navalshipcode.org/faqs/>

5. RCN non-combatant ship — a vessel not intended to be exposed to armed conflict, but may be used in a constabulary role and equipped with limited offensive weaponry.

6. Third party — a conformity assessment activity that is performed by a person or body that is independent of the person or organization that provides the object, and of the user interests in that object (ISO/IEC 17000).



Figure 2. The Classification Process

LR and ABS⁷ have extensive experience and presence in the marine industry. LR has more than 250 years of experience in marine safety assurance, and a world-wide network in more than 75 countries. ABS has more than 150 years of similar experience, and a network stretching across more than 70 countries. Both classification societies are available

by way of long-term contracts that enable easy access to their services by the naval support community. The availability of ROs will provide a notable increase of breadth and depth of experience to the RCN, including additional 24/7 access to a worldwide network of domain experts and technical investigation teams. Furthermore, the long-term contractual arrangements will enable easy and consistent access to classification society surveyors within the Formations, enabling smart customer knowledge transfer. LR surveyors will be embedded in the Fleet Maintenance Facilities (FMFs), and options are available to have ABS as part of the Arctic and Offshore Patrol Ships and Joint Support Ships In-Service Support (AJISS) integrated project teams.

The leveraging and availability of the ROs comes at an opportune time with the aging of the current fleet and the arrival of new ships. As shown at Figure 3, the legacy fleet and new ships will coexist at opposite ends of the maintenance Bathtub Curve⁸ where heightened focus on materiel fitness is necessary. RO activities will complement the current naval materiel assurance activities within the Formations, and support the operational imperative by providing additional confidence in risk-based decisions.

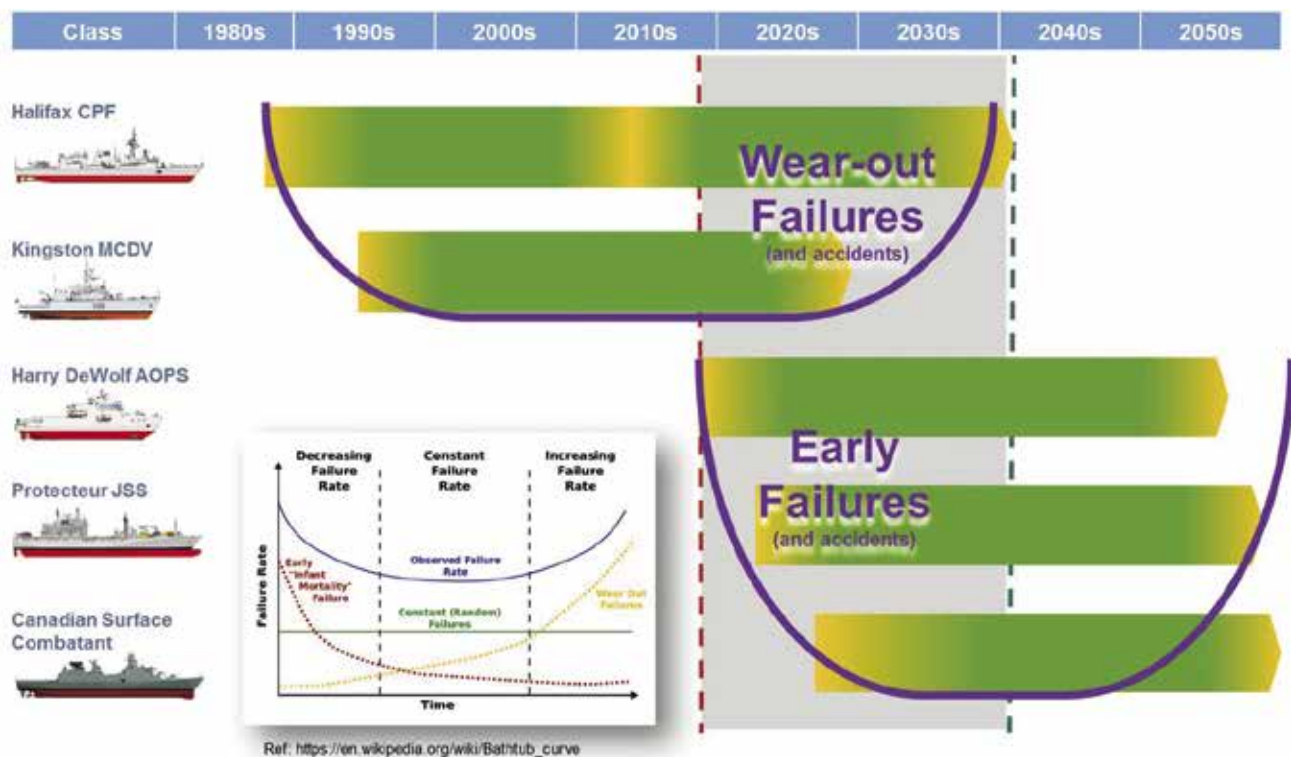


Figure 3. Legacy and Future Fleets – The Edge of the Bathtub curves

7. LR website www.lr.org; ABS website ww2.eagle.org

8. Bathtub Curve – a reliability domain reference to a time versus failure rate curve for equipment.

Working with classification societies within the RCN will be a new experience for many, but it should be noted that the Orca-class patrol vessels have been maintained in classification by ABS for the past 12 years. More broadly, Transport Canada has designated classification societies as ROs for 18 years as part of legislative requirements for Canadian-flagged ships. For any organization that works with an RO, the objective remains the same: Assure that a ship's design and materiel complies with a set of rules or other technical standards that have been shown to be appropriate for the function of the ship or system. This does not cover every structure or piece of equipment of a ship, but generally covers the systems essential to its operation.

The use of the ROs and the classification process will be customized for different RCN ship classes in order to support the RCN Strategic Objective of improving the delivery of materiel sustainability to the RCN fleet. For example, because the *Halifax* class is a legacy combatant ship with which the RCN has over two decades of experience, RO activities will be applied incrementally, by NSC key hazard area, to complement and enhance the existing materiel state validation program led by the Formation Technical Authority.⁹ Alternatively, for the Canadian Surface Combatant (CSC), the RO authorization will include the full scope of the NSC key hazard areas throughout the design, construction, and in-service phases. This will provide third-party assurance that the CSC ships will function as expected when delivered to the RCN, and throughout their service until eventual disposal.

It must be re-emphasized that RO activities are conducted throughout all phases of a ship's life cycle, and encompass activities beyond physical surveys aboard ship. RO activities can occur during design, maintenance, material supply and overhaul, construction, third-line work periods, and within the engineering change process. For example, a key benefit of employing ROs is the increased level of assurance gained through independent inspection of the supply chain and the output of third-line activities. This independent third-party insight assists in demonstrating that materiel fitness of a vessel in key hazard areas has been benchmarked against internationally accepted naval safety best practices.



Capt(N) Jacques Olivier, Naval Materiel Regulatory Authority, seated with John Hicks, President – Americas Marine and Offshore, Lloyd's Register, at the signing ceremony on November 15, 2018.



The January 25, 2019 RO signing event with (at centre) Capt(N) Jacques Olivier, Naval Materiel Regulatory Authority, with John McDonald, Senior Vice President, Western Hemisphere Operations, American Bureau of Shipping.

The long-term contractual support of Recognized Organizations will be a significant enabler for the RCN and ADM (Materiel). RO approval is a milestone accomplishment for the RCN Strategic Plan, the Naval Materiel Management System, and naval materiel assurance.



Capt(N) Jacques Olivier is the Director of Naval Platform Systems (DNPS) and Naval Materiel Regulatory Authority (NMRA). Cameron MacDonald is the Naval Materiel Regulation section head within DGMEPM.

9. Definition of Formation Technical Authority - The designated office in the operational chain of command that has the authority to interpret technical policies, orders, standards and specifications flowing from the Naval Materiel Authority.

FEATURE ARTICLE

Aquatic Invasive Species — A Freshwater Ballasting Solution for the RCN

By Douglas Green

The International Maritime Organization's (IMO) Ballast Water Management Convention (BWMC) came into force in September 2017. This convention is designed to address the threat of aquatic invasive species transported by ships' ballast, and reflects the growing concern on this issue in the past several years. To address the need for ballast water management, the RCN has implemented plans to meet these requirements for its vessels. This includes an engineering change for the *Halifax*-class frigates to use fresh water from the ships' onboard desalination system as a ballasting medium, with HMCS *Calgary* being the first to implement this engineering change in 2017 (see sidebar). Further to this, all upcoming ship classes will have accommodations for ballast water management built into their designs.

Ballast Water Aquatic Invasive Species — International Response

Ballasting is necessary for ship stability as it manages a ship's safe centre of gravity during varying sea states and loads. During extended transits without replenishment support, ballasting offsets the diminishing weight of a ship as fuel, ammunition and food are expended. It is also critical in compensating for damage through battle or accident in order to retain stability and mobility. Traditionally, this has been accomplished by using seawater as the ballasting medium. However, this approach can be a transport mechanism for thousands of species, such as aquatic animal larvae, microbes, algae, and viruses. Non-native species can overrun local ecosystems without the checks and balances of predators, or the natural competition of their original environment. Many invasive species to Canada have the potential to be carried in ballast water, such as the zebra mussel, European green crab, and Japanese skeleton shrimp. Reports from the World Wildlife Fund indicate that these invasions have caused approximately \$54 billion in damage worldwide in the last five years alone.

The zebra mussel is a well-known example, first being reported in the Great Lakes in the 1980s. Speculation is that the first wave of the invasion was the result of ballast water released into the Great Lakes from a vessel originating in the mussel's native Black Sea habitat. Zebra mussels have since colonized many of North America's inland waterways, and have now reached as far west as California. They have also been detected on recreational craft entering British Columbia waters. Zebra mussels completely cover surfaces in newly established waters, suffocating native mussels, clams and plants, altering the food chain, and even the water clarity and composition through its filter feeding. Severe economic impacts occur through the clogging of water intakes and fouling of in-water structures and vessels.

In 2004, the IMO introduced the BWMC to address the increasing threat of aquatic invasive species (AIS). The convention's goal is to implement internationally recognized standards for ballast water management that allow states to work together to prevent, reduce and control introductions of non-native species to new environments. Canada ratified this convention in 2010 and introduced the Ballast Water Control and Management regulations into the Canada Shipping Act, in 2011. On Sept. 8, 2017, with enough nations ratifying the convention, the IMO's BWMC regulations came into force.



Photomicrograph of plankton, typical of those found in ballast water. The IMO ballast water performance standard (Regulation D-2) contains concentration standards for the amount of viable microscopic aquatic organisms.

Photo credit: Fisheries and Oceans Canada.

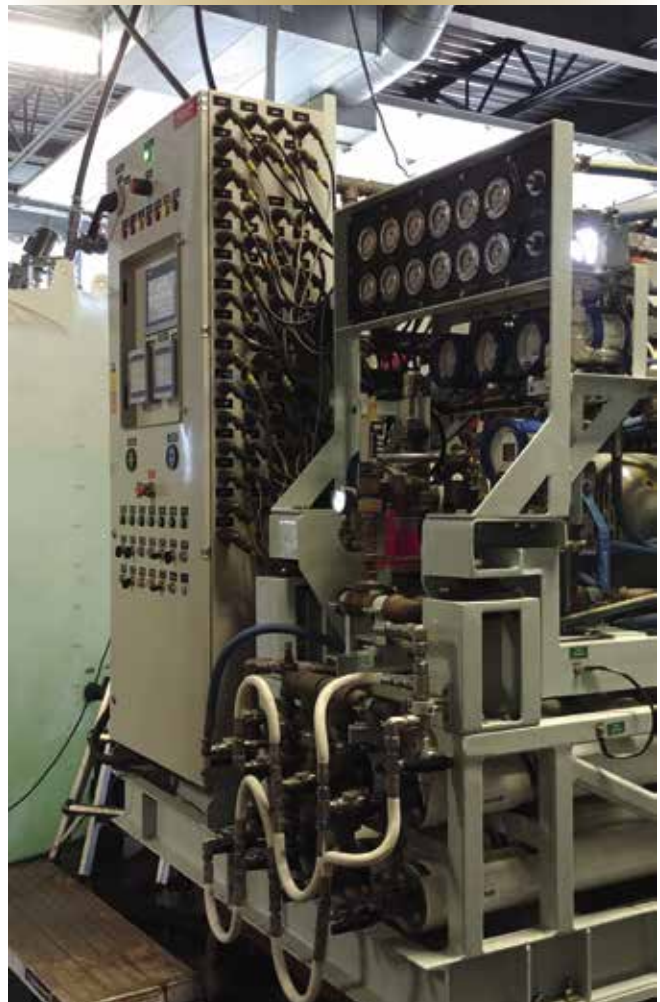
A key component of the BWMC is 'Regulation D-2' — a ballast water performance standard for the maximum allowable concentrations of viable organisms in discharged ballast. To meet these standards, all ships that the convention applies to will have to perform onboard treatment of their ballast water, or have an alternative ballast water management system.

Defence Administrative Orders and Directives (DAOD) 4003 states that DND/CAF shall meet or exceed the spirit of all federal laws, requiring environmental baselines for ships based on the most stringent regulations likely to be encountered on international deployments. As a result, the Director General Maritime Equipment Program Management (DGMEPM), in consultation with RCN stakeholders, reviewed the convention, legislation, policies, and ballast water practices to determine the best way to meet these upcoming regulations for existing and future RCN vessels.

Halifax Class – Freshwater Ballast Solution

The *Halifax*-class frigates are equipped with four ballast tanks that were originally configured to use untreated saltwater or distillate fuel oil as their ballasting mediums. When reviewing options for meeting the BWMC's requirements, the Naval Engineering Test Establishment (NETE) advised DGMEPM that installation of a ballast water treatment system was limited by a lack of available space on board, and by the cost of installing such a system with all the required piping. Therefore, an alternative system was chosen that uses freshwater ballast generated by the existing shipboard reverse osmosis desalination (SROD) equipment. An engineering change (EC #20120031) was implemented in 2016 to install one-way piping from the existing freshwater system to supply the ballast tanks.

The four ballast tanks on-board a *Halifax*-class ship contain approximately 160 cubic metres total volume — orders of magnitude smaller than most commercial cargo vessels. The current combined production rate for the two Mk IV SRODs on the *Halifax* class is approximately 960 gallons/hr, or 3.6 m³/hr. With proper management this rate of production will be more than adequate to meet the water demands of ships' personnel, and ballast the ship. In order to maintain the ships' operational capabilities, the ballast tanks still retain the capability to act as reserve fuel reservoirs if required, or may be filled with seawater, as before.



Mk IV Shipboard Reverse Osmosis Unit from BluMetric Environmental Inc.

Reverse Osmosis (RO) Process

Separate to the freshwater piping change, the *Halifax* class is also undergoing an upgrade to the SROD system that promises to increase the water production rate and efficiency of the units. The Mk IV SROD system uses two sequential processes to purify seawater for use on board. The first is an ultrafiltration (UF) pre-filtration process that prevents suspended solids from passing, using a filter pore size small enough to remove almost all potential AIS down to virus size particles. The water from the ultrafiltration process is then fed to the reverse osmosis units, which remove ions to desalinate the water. The fresh water is then brominated to ensure it is safe to drink. Purifying to

Continued on page 19

HMCS *Calgary* — first freshwater ballasting operations

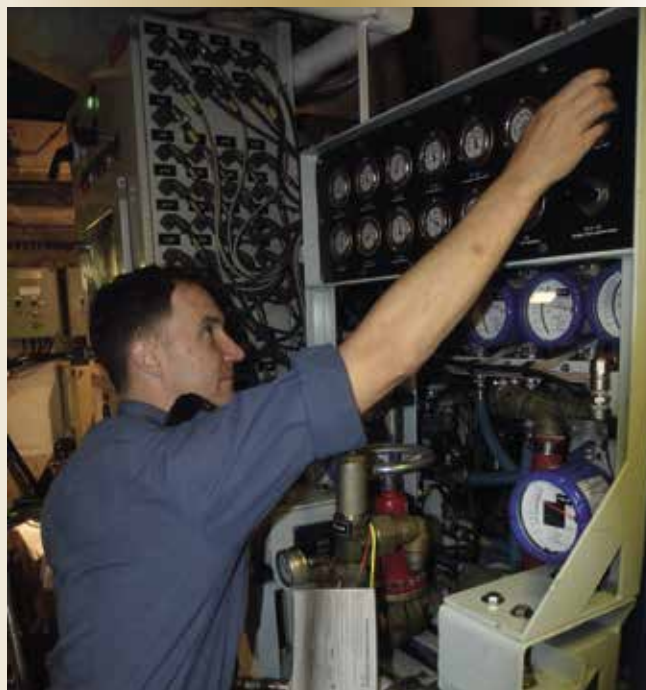
By Lt(N) Paul LePrieur (MESO HMCS *Calgary*)

In 2017, HMCS *Calgary* became the first ship to install the new freshwater ballasting system. *Calgary* was chosen, in part, because it was one of the first ships, along with HMCS *Halifax*, to upgrade to the latest Mk IV SROD systems for producing fresh water.

Calgary's first freshwater ballasting evolution occurred on April 10, 2018. Using water from the freshwater storage tanks (64.1 m³ combined volume), No. 1 Ballast Tank was filled over approximately one hour. The ballasting evolution decreased the freshwater storage level from 90 percent to 40 percent, and replenishment of the freshwater tanks was completed over an 18-hour period with no water restrictions being placed on the ship's crew. The reason this methodology was chosen is because the pumps from the freshwater storage tanks have a much higher output flow rate of 14 m³/hour, compared to that of the two SROD plant pumps at just over 1 m³/hour each when operating in local British Columbia waters.

The second freshwater ballasting evolution was conducted on August 5, 2018. This time, however, No. 2 and No. 3 Ballast Tanks were filled directly from the two SROD plants. Unlike No. 1 Ballast Tank which is on the ship's centreline, Nos. 2 and 3 are port and starboard tanks, and must be filled concurrently to avoid listing the ship. This evolution was completed over a 14-hour period, for an average fill rate of 4 m³/hour using both SROD plants. The increased output was due primarily to the higher ambient water temperature *Calgary* was operating in at the time, and to some minor adjustments made by ship's staff to increase the flow by adjusting the system back-pressure. During the evolution, fresh water via No. 1 and No. 2 Storage Tanks was used to provide domestic consumption only. The lowest level of fresh water reached was 65 percent (i.e. no water restrictions), and freshwater replenishment took eight hours.

To summarize, filling the 31.1-m³ No. 1 Ballast Tank using the freshwater storage tanks took 19 hours, including the time it took to replenish freshwater supplies. However, the 55.2 m³ larger combined volume of ballast tanks No. 2 and No. 3 was filled in only 22 hours using water production directly from the SROD plants. This may seem counterintuitive based on the much faster fill rate



associated with the freshwater pumps, but ballasting directly from the freshwater tanks also drains freshwater storage very quickly. Even if the ship were to drain the freshwater tanks completely (although 50 percent is the lowest we would typically go), there is not enough freshwater storage in the tanks to fill No. 2 and No. 3 Ballast Tanks in one attempt. Therefore, ballasting No. 2 and No. 3 Ballast Tanks via the freshwater tanks would have to be done in four phases, with two ballasting phases and two freshwater replenishment phases. During planning, we calculated that the time it took us to replenish fresh water would more than offset any time saved by using the faster fill method. Using the SROD plants to ballast actually shortens the entire evolution by 12 hours.

This recent ballasting operation is a major improvement with respect to time, albeit previous seawater ballasting methods could accomplish filling tanks No. 2 and No. 3 in approximately 30 minutes (one hour if you include setup time) with no impact to fresh water. While there is clearly room for efficiency improvements, the data collected by HMCS *Calgary* in these early stages will play an important role in the development of future modifications to bring better performance to the new process.



potable water standards effectively removes any potential invasive species, thus meeting the intent of the D-2 regulations for ballast water.

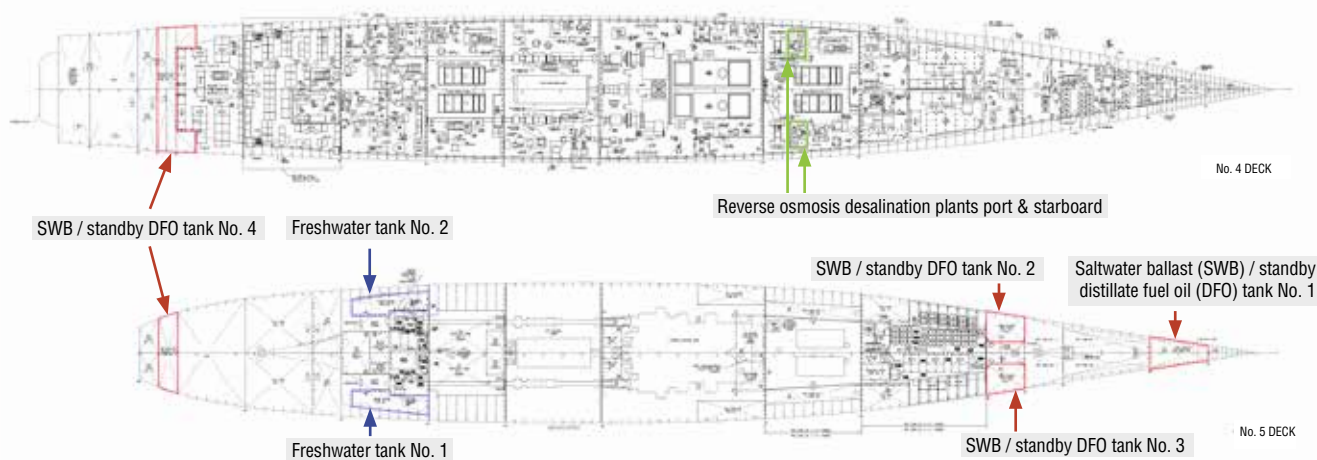
Improvements on the Mk IV over the Mk III include an automatic self-cleaning strainer and the ultrafiltration system with automatic back-flushing. High-efficiency Danfoss Axial Piston Pumps were also recently introduced to existing SROD units. These improvements will assist in reducing maintenance and cleaning requirements, while extending the life of the RO membranes. Decreased fouling of the RO membranes will reduce the flushing required, and allow for a lower flow velocity and higher pressures across the membranes, which will lead to higher freshwater permeate production through the membrane.

Additionally, a Maritime Evaluation for testing an energy recovery device for the Mk IVs is being drafted. The device is designed to transfer water pressure from the saltwater concentrate (brine) outflow of the RO units to the saltwater feed of the units. Shore-based trials were run by NETE at the ROD system's manufacturer BluMetric Environmental Inc. that indicated energy savings of 42 percent for the Mk IV ROD unit with the energy recovery device installed. The test was also run at an increased production rate of 2.4 m³/hour vs. the standard Mk IV set-up of 1.8 m³/hour. These possible upgrades to the SROD system will result in a more environmentally friendly and economical process that has greater capability to meet the increased water demand from freshwater ballasting.

Current & Future Shipbuilding Projects

All current and future shipbuilding projects in the RCN will be required to take the management of their ballast water into account in their design process going forward. The *Harry DeWolf*-class of Arctic and Offshore Patrol Vessels (AOPV) is the first of these projects, with the lead ship of the class launched Sept. 15, 2018. The AOPV has 12 ballast water tanks with a total volume of 1047.6 m³, plus two heeling tanks each of 197.4 m³ — greater capacity than that of the *Halifax* class (i.e. four tanks, of about 160 m³ total capacity). One of the objectives of the *Harry DeWolf* class is enforcing Canada's sovereignty in the Arctic during a time of changing climate. Both higher Arctic temperatures and the increased possibility of shipping due to lessened sea ice have generated concern that AIS will establish in the previously untouched and fragile Arctic environments. The class design includes a ballast water treatment system and a ballast water management plan that will meet the IMO convention requirements.

The specific ballast treatment system on the AOPV is an Ocean Guard RayClean system designed by DESMI, which employs two main treatment processes — a mechanical filtration process followed by a UV radiation treatment. The mechanical filtration uses a 30-micron rated filter that removes most marine life and other large particles from the sea water. The UV radiation unit contains low-pressure UV-C lamps, which have their intensity automatically adjusted depending on the clarity of the water. The UV process is



Location of reverse osmosis desalination (ROD) units and various tanks aboard a *Halifax*-class frigate.



New pipes and valves installed for the freshwater ballast engineering change on HMCS *Calgary*.

designed to kill microscopic and embryonic life that has passed through the filter stage. Both the mechanical filter and the UV lamps employ automatic cleaning processes to reduce the need for manual maintenance. The treatment process is run during both intake and discharge of ballast water to ensure discharged water is free of potential AIS. The system is effective at treating water independent of salinity and temperature, and its type is on the list of approved treatments in the BWMC.

Other upcoming ship classes like the Joint Support Ship (JSS) and Canadian Surface Combatant (CSC) are being designed to adhere to the BWMC. The JSS project is the next of these, with the lead ship, HMCS *Protecteur* expected to launch in the early 2020s. JSS will have a resupply role for the RCN, providing fuel, spare parts, food, water and other supplies to the deployed fleet, and ballasting is expected to be a continual and dynamic process. Current plans for the class include a fully IMO-compliant ballast water treatment system with a corresponding ballast water management plan.

Conclusion

Demonstrating the Navy's commitment to environmental protection, the freshwater ballasting engineering change will continue to be implemented on the *Halifax* class during scheduled docking work periods, with expected fleet-wide completion in 2023. The lessons learned as each ship explores the capabilities of the new system are being shared throughout the fleet. DGMEPM and its partners will continue looking for new, innovative methods for addressing aquatic invasive species in ballast water that exceed the environmental expectations of the Canadian and international maritime communities.



Douglas Green is a NETE (Naval Engineering Test Establishment) support for the Biofouling Focus Group in DNPS 6.

CONFERENCE & EXHIBITION

MARI TECH

FULL SPEED AHEAD: FIRING ON ALL CYLINDERS

SAVE THE DATE!

OTTAWA | April 23-25 | 2019

KEYNOTES

- Technical Sessions & Workshops
- Exhibitors
- 400+ participants
- Networking events

and much more...

SNAME

mari-techconference.ca

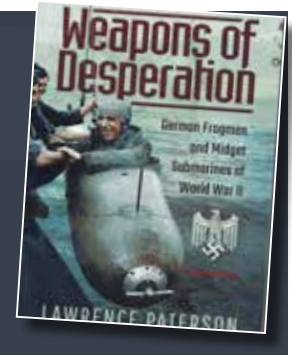
BOOK REVIEWS

Weapons of Desperation: German Frogmen and Midget Submarines of World War II

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

Frontline Books – An imprint of Pen & Sword Books Ltd. Email: info@frontline-books.com

ISBN 978-1-52671-347-6 [Paperback £16.99]; 256 pages: 16 pages of black & white photos; glossary; comparative rank table; appendix; endnotes; bibliography; index.



Adolf Hitler and the Nazi High Command figuratively “burned the furniture” in the dying days of the Second World War in a futile attempt to turn ignominious defeat into glorious victory for the Third Reich. Some of their innovations, such as the V1 and V2 rockets that rained terror on London and Southern England, might have turned the tide of war if they had been developed earlier – especially since they were the prototypes for a far deadlier weapon. German scientists were racing against time to develop: the atomic bomb.

But other devices were ill-conceived, rushed into production and doomed to failure. Such unconventional weapons as midget submarines and radio-controlled

explosive boats resulted in the loss of untold numbers of lives among the ranks of those who were developing them or who eventually would be called upon to operate them in what were little better than suicide missions.

So popular was Lawrence Paterson’s first edition of *Weapons of Desperation*, released in hard cover in 2006, that it was published again in paperback in 2018. The author went to considerable effort to locate and interview ex-sailors of the German *Kriegsmarine* and various Allied navies to collect a wealth of material on the effectiveness – or more realistically the ineffectiveness – of these “weapons of desperation.” The rare photographs themselves are well worth the purchase price.

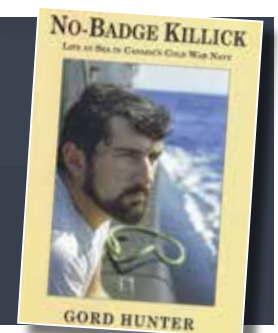


No-Badge Killick — Life at Sea in Canada’s Cold War Navy

Reviewed by Brian McCullough – Production Editor *Maritime Engineering Journal*

2018 Monkey’s Fist Publishing (\$20 <http://www.nobadgekillick.blogspot.ca/>)

ISBN-978-0-9681803-1-0 (Paperback, 189 pages, photographs)



Readers familiar with the old blue uniform ranks of the Royal Canadian Navy will immediately catch the humour in the title of Gord Hunter’s book. As he explains in his introduction, a “killick” — a leading seaman, in naval parlance — who is not wearing a good-conduct badge (chevron) on his sleeve, has clearly made one or more unsuccessful appearances before the captain’s table as a defaulter.

And thus begins Hunter’s engaging reminiscence of his short career as a naval sonarman from 1962 until 1970. For anyone who served at sea back in the day, the unvarnished recollections of life aboard the sleek new “Cadillac”

destroyer escorts and Oberon-class diesel-electric subs, of the trips south and across the pond, are like our own familiar stories. Hunter’s evocative descriptions capture the essence of this bygone era beautifully.

Gord Hunter may have been a no-badge killick thanks to a single lapse in good judgment, but he deserves a full pardon for this insightful memoir of a sailor’s life aboard the ships and submarines of Canada’s Cold War Navy.



NEWS BRIEFS

RCN Chief Engineers



It is always great to see **RAdm Bill Christie** (centre) at our Ottawa-area naval technical functions. The 99-year-old joined the RCN in 1941, and served in the Chief Engineer position as Director General Maritime Systems from 1970-1972. Here he is at last November's Niobe Mess Dinner at the HMCS Bytown Wardroom with two of his successors — **Cmdre Simon Page** (above left) who was DGMEPM from 2015 to 2018, and **Cmdre Chris Earl**, our current Director General Maritime Equipment Program Management.

To read a transcript of RAdm Christie's informative and entertaining 2006 interview with the CNTHA Oral History Project, go to: <http://www.cntha.ca/tech-hist/oral-written-hist/histories/billchristie.html>



Photos courtesy Anne Patenaude,
HMCS Bytown Wardroom

RAdm Christie with his son Peter.

Launch of the future HMCS *Harry DeWolf*

First for the Royal Canadian Navy under the National Shipbuilding Strategy! The first of its class, the future HMCS *Harry DeWolf* (AOPV-430) was launched at the Irving Shipbuilding's Halifax Shipyard in Nova Scotia on Sept. 15, 2018. It marks a significant milestone for the Arctic and Offshore Patrol Ship (AOPS) project, now a step closer toward delivering six new ice-capable patrol vessels to the RCN.

For the launch, the ship was floated off a submersible transport barge in Bedford Basin, then towed back to the pier alongside Halifax Shipyard later in the evening. Delivery of AOPV-430 to the Navy is expected later this year, following successful completion of sea trials and other acceptance activities.



Photo Courtesy MATFLASH

AWARDS

2018 Rheinmetall Award



Photo courtesy PO1 Pete Fraser

PO2 Sean Barret

Top Weapons Engineering Technician exhibiting outstanding performance and conduct in trade
(With *François Desmarais*)

2018 Lockheed Martin Canada Award



Photo by Brian McCullough

Lt(N) Ben Mullin-Lamarche

Top Combat Systems Engineering Phase VI candidate
(With *Patrick St-Denis*)

2019 NTO Spirit Award RAdm (Ret'd) Mack Silver Plate



Photo by Brian McCullough

Lt(N) Sam Poulin

For demonstrating the spirit that enables naval technical excellence
(With *Mr. Patrick Finn, ADM Materiel*)

The Maritime Engineering Journal is always pleased to share your good news stories. Send us your short write-ups and high-resolution photos as separate email file attachments addressed to: brightstar.communications@sympatico.ca



News

Canadian Naval Technical History Association

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

Preserving the RCN's ceremonial flagship – HMCS *Haida*

By Alan Lenarduzzi



In 2016 and 2018, docking and refit work was carried out on Canada's "fightingest ship," the now 76-year-old Tribal-class destroyer, HMCS *Haida*. Since 2002, the ship has been a floating National Historic Site under the care and supervision of Parks Canada in Hamilton, Ontario, and last year was designated as the ceremonial flagship of the Royal Canadian Navy. The refit work, needed mainly to repair and preserve the ship's steel structures, was conducted by primary contractor Heddle Marine Service Inc. in Hamilton, along with local subcontractors.

HMCS *Haida* had her keel laid in England in September 1941, and was commissioned in August 1943. The ship saw extensive service during the Second World War and Korean War. In 1965, two years after the ship was decommissioned from the RCN, a group of naval veterans purchased *Haida* and moved her to Lake Ontario. Today, Friends of HMCS *Haida* [www.hmcshaida.com] continue to support the ship through their mission of "preserving, promoting and protecting the legacy" of *Haida* through multi-tiered education programs.

The intent of the docking in 2016 was to add steel cladding where survey had indicated some thinning of the hull plates. The work also included replacement of wasted hull framing and interior steel decks. In addition, all openings in the hull, including the sonar

dome cavity and the stern tubes for the propeller shafts, were sealed to prevent any further ingress of water, and to ensure the long-term integrity of the hull. Magnesium anodes were affixed to the hull to mitigate any potential future corrosion. Finally, the underwater hull was given two coats of epoxy and two coats of anti-fouling paint, while the hull above the waterline was given two new coats of paint.

The latest work in 2018 included necessary repairs to the steel weather decks, painting of the superstructure, and a safer modern electrical infrastructure that meets code. The ship looks fantastic, a tribute to the officers and men who crewed her. HMCS *Haida* National Historic Site at Pier 9 in Hamilton Harbour is a piece of our naval history that remains an important connection to the past for current and future generations who may want to know more about Canada's role in times of war and peace.

CNTHA member Alan Lenarduzzi is Senior Marine Engineer at SeaTyme Marine in Ottawa. He is part of a team of ship repair experts who support, inspect and oversee marine work for Parks Canada.



Canada