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Maritime Engineering Journal

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Featured Content

HMCS *Shawinigan*'s engineers show how pre-deployment technical readiness is the key to mission success

CNTHA News Inside!

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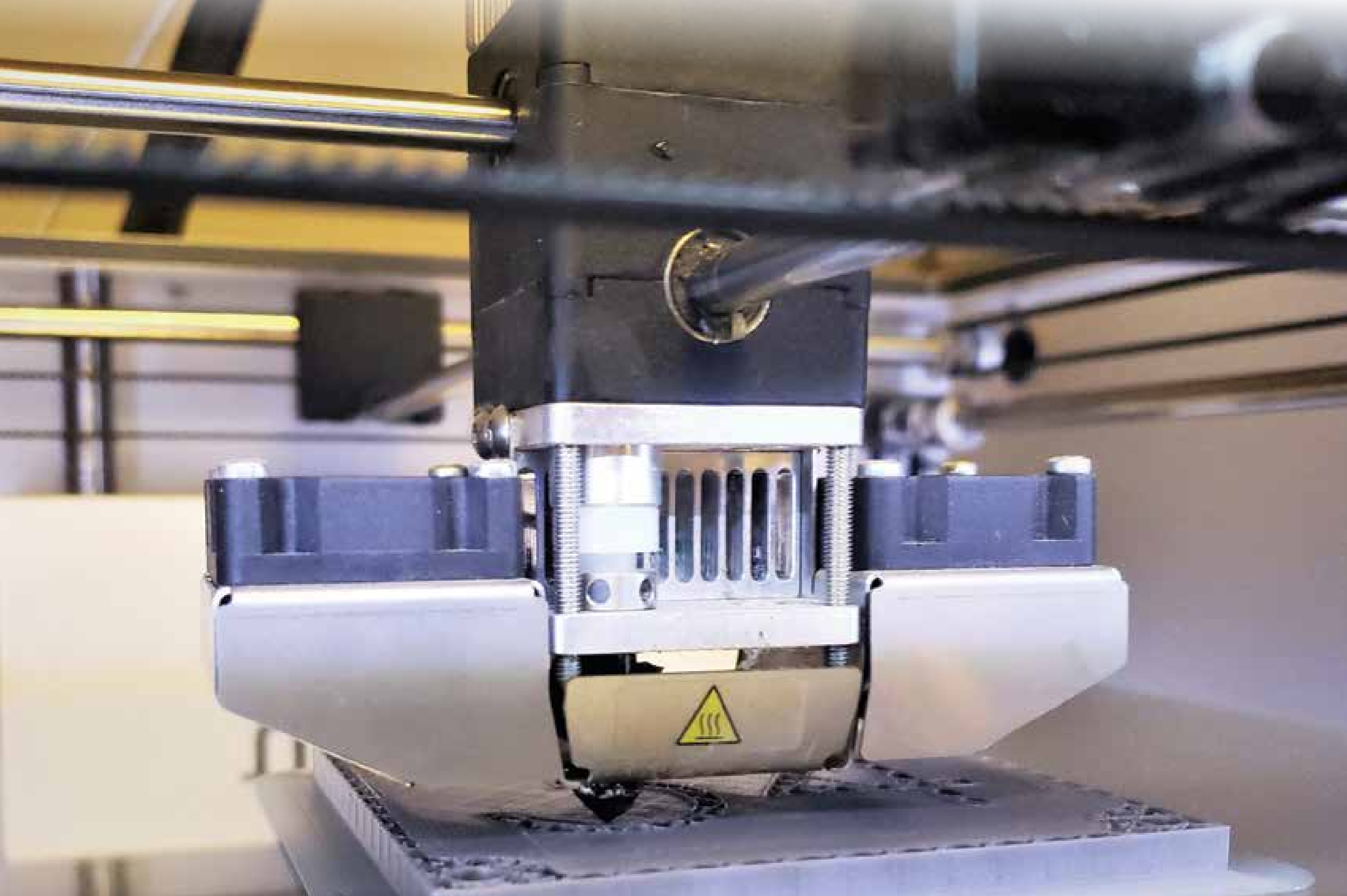
Photo by Lt(N) Christopher Chang, FMF Cape Scott


Photo by National Research Council of Canada

Fighting the War on Shipboard Corrosion

Galvanic corrosion is a common sight aboard older fleet units, but the Royal Canadian Navy is turning to new initiatives in corrosion awareness and to the emergence of additive manufacturing techniques by the Fleet Maintenance Facilities to reduce overall corrosion of ships in future.

Our coverage on Naval Galvanic Corrosion Awareness begins on page 13.

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(Established 1982)
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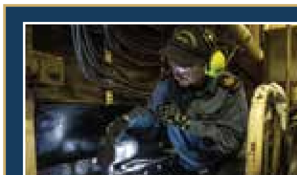

HMCS *Shawinigan*'s pre-deployment engineering readiness program played a critical role in achieving mission success on Op Caribbe during the summer of 2021.
(Photo courtesy HMCS *Shawinigan*)

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COMMODORE'S CORNER

A Note of Optimism for the New Year

By Commodore Lou Carosielli, CD

I don't think it would be any exaggeration to say that the COVID-19 pandemic has changed the way we live, the way we work and, in particular, the way we communicate. Most of us were already fairly regular users of various online methods for keeping in touch with family, friends and work associates before the pandemic hit, but we were also used to having a socially healthy routine of simply being around other people. We've all struggled with the effects of the forced isolation, and I salute every one of you who continues to do what you can to mitigate the situation for yourself and others.

As a naval technical community, I believe we have excelled in our ability to carry on with the tasks at hand so that the Commander of the Royal Canadian Navy continues to have ships and crews that are ready in all respects to deploy as required. The successful sailings of HMCS *Harry DeWolf* and HMCS *Shawinigan* this past year are just two cases in point where the RCN was able to demonstrate its commitment to fleet renewal in the first instance, and in *both* cases, Canada's determination to work with international partners to impede the flow of illicit drugs that bring so much harm to our home communities.

It bears reminding ourselves that the crews of these two ships, and of the other high-readiness fleet units that have deployed around the world since the beginning of the pandemic (or that soon will be doing), have undergone strict pre-sailing quarantine protocols. While these necessary precautions have been extraordinarily effective, there is no question that they have placed an enormous burden on the sailors and their families, and I ask that you spare a kind thought for them as we turn the corner onto a new year.

In my own situation, the first opportunity for me to conscientiously undertake any Navy-related travel to the coasts since being appointed as DGMEPM in July 2020 came just last month, during the first week of November, when I flew to Victoria to attend the MARPAC Naval Technical Seminar and other meetings. Having to wait 16 months before meeting our teams in the dockyards was not how I wanted to start my term as the new chief engineer, but kudos to all of you who helped to build linkages, relationships and understanding across thousands of kilometres and multiple time zones. Without your effort, we never would have survived the crises and daily fires.

Photo by LCdr Cindy Hawkins

Honorary Capt(N) Jeanette Southwood joined Cmdre Lou Carosielli, DGMEPM, in Esquimalt, British Columbia for technical visits and tours in early November.

It was a great trip out west, and I was so pleased that our own Naval Technical branch's **Honorary Capt(N) Jeanette Southwood** was able to fly out from Ottawa to join the various visits and tours we had scheduled for her, including the NT seminar. She was keenly engaged all week in learning more about the special nature of our branch, and about the work that goes on behind the scenes to keep our fleet ready for sea. She even gamely suited up to try her hand as a "firefighter" at the nozzle end of a fire hose at Damage Control Training Facility Galiano. This accomplished professional engineer will be the subject of a feature in our upcoming Spring 2022 edition — the 100th issue of the *Maritime Engineering Journal* since its launch in 1982.

For myself, the days in Esquimalt and elsewhere were also long and satisfying. I was able to meet with many people who offered me valuable insights into the current situation regarding West Coast fleet maintenance activities, training and operations, and other perspectives on the importance of ensuring a safe and respectful work environment, and healthy work-life balance for everyone. Here's a quick rundown of how the week of Nov. 1-5 went:

Day 1

Monday morning started off with an office call on **RAdm Angus Topshee, Commander of Maritime Forces Pacific**. While this would normally be a routine occurrence, these are not normal times. It was really my first opportunity to personally thank him for his engagement with our naval technical community over the past year. We would hear from him later during the seminar. A visit with **Fleet Commander Cmdre David Mazur** followed, and while his focus on maximizing operational outputs should not come as a surprise to anyone, the "lens" of being a smarter customer while dealing with aging fleets certainly made for an interesting conversation.

The latter half of the day was spent with our industry partners at Victoria Shipyards and Babcock Canada, where I had the opportunity to walk through our vessels that are undergoing scheduled maintenance work periods. There is not much that can take the place of being at the proverbial coal face in person, and seeing first-hand how the technical challenges of maintaining an aging fleet are being handled with energy and professional pride.

Day 2

Tuesday got underway with tours of Fleet Maintenance Facility Cape Breton and our training establishments, where people kindly took the time and effort to make me a little bit smarter about the work they do and the challenges they face. While I plan to visit with many more of you on my next visit, the takeaways from this day would inform further discussions during the high-level meeting that was coming up next, and throughout the NT seminar on Wednesday and Thursday.

The fall Naval Engineering Council meeting that followed rolled out smoothly, and I can't say enough about the power of the hybrid attendance format that facilitated active participation by chief petty officers and commanders from across the country. I hope this is one of those pandemic changes that sticks around. It was a packed meeting, and I am so appreciative of the dedication and focus of the presenters who led us out on such topics as culture change, challenges facing women Naval Technical Officers, mentorship, the Mar Tech Action Plan, and the overall health of the occupation. Many of the seeds that were planted during this session will grow to bear fruit as we continue to move forward as a community in ways that better serve ourselves and the fleet.

Days 3 and 4

The MARPAC Naval Technical Seminar was the heart of my visit, and something I had been looking forward to attending in person ever since the pandemic closed so many things down. It was wonderful to finally be meeting "face-to-safely-distanced-face" with such a broad spectrum of the engineering, technical and other support personnel who manage our West Coast fleet technical activities, both afloat and ashore.

The seminar definitely did not disappoint, with an agenda covering key issues affecting the RCN's technical branch as we manage the fleet-in-being, while advancing the Navy's fleet renewal program. Again, it was great that folks from coast to coast could join online for what was an enlightening two days of detailed presentations.

RAdm Topshee's sobering command overview focused in part on the importance of evolving our culture toward more meaningful inclusiveness, as a baseline from which we can move forward together as a Navy. This will be so important as we embark on exciting new strategies to shore up recruitment in the technical ranks. The admiral also urged us to empower the right people with the responsibilities they need to tackle everything from fixing the urgent training issues, to mitigating technical risk to *acceptable* levels. In a general sense, he said it's about people talking to one another, and finding options that will lead us forward in decisive, significant ways.

The seminar moved into its final phases with some overdue NTO awards – *Bravo Zulu to all the winners and candidates!* – and closed off with a successful town hall session aimed at keeping our lines of communication open and honest. It was an outstanding couple of days, and I offer my thanks to the organizers and presenters.

Day 5

With a last-minute meeting cancellation on the Friday, my home team three hours ahead in Ottawa quickly had me in a rental car and on my way up-island for my first shore-side visit to the Canadian Forces Maritime and Experimental Test Ranges (CFMETR) at Nanoose. It was good to have a chance to better understand the challenges that this dual-nation team faces in maintaining a world-class operational underwater test capability for both Canada and the United States.

(Continues next page...)

The nice part about the drive back to Victoria was having a couple of hours to myself, unable to check e-mail, and just reflecting on the importance of building and sustaining relationships from one end of our enterprise to the other. The sooner we can get back to having our usual sidebar discussions, the random crossings, the crazy off-the-cuff ideas the better, as we need to ensure these have a place in what we do. Technology has made communication easier in so many ways, but it can sometimes force us into becoming a bit "too efficient."

Being able to meet-up in person adds a huge dimension to the work we do, and to the way we live our lives, but is not something we can ever take for granted. While I was out west, the team was saddened to learn of the loss to cancer of **Capt(N) (Ret'd) James Carruthers, PhD, P.Eng., RCN**, a long-standing member of our close-knit naval technical community, and a former president of the Naval Association of Canada. Jim's visionary technological outlook and dogged pioneering perseverance in the world of naval combat systems engineering resulted in products that made the Royal Canadian Navy a world leader in digital systems integration, and changed forever the way we communicate and operate our systems aboard ship. Jim was a great friend and mentor to many of us, and he will be dearly missed. I extend our community's sincere condolences to his family.

Like everyone else, I am looking forward to putting the pandemic restrictions behind us so that we can all engage more fully with one another at work, and with our friends and family members wherever they may be. As we greet the New Year, let us do so with optimism, and with care for one another so that we may all enjoy a safe and prosperous journey ahead.

In memoriam

Capt(N) (Ret'd) James Carruthers, PhD, P.Eng., RCN

May 14, 1943 – Nov. 1, 2021

The naval technical community was saddened to learn of the death of this visionary naval engineer to cancer on Nov. 1. Following the celebration of Jim's life planned by his family for next summer, the *Maritime Engineering Journal* will share more details of this remarkable man's role in the RCN's transformation to digital systems integration.

https://colefuneralservices.com/tribute/details/7797/James-Jim-Carruthers/obituary.html

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 at MEJ.Submissions@gmail.com.

FORUM

The Royal Navy and Royal Canadian Navy Technical Communities: Shared Challenges and Opportunities

By Lt Cdr Francis Griffiths, RN

As a Royal Navy (RN) Marine Engineer Officer who has just completed an exchange posting with the Royal Canadian Navy (RCN), this article aims to highlight some observations on the shared challenges and opportunities that exist between the RN and RCN, and to advocate for further strengthening the working relationships between our two technical communities.

It is easy to assume that issues are unique to your own organization, but working with the RCN has shown me that we face many common challenges where there is ample opportunity to share information that would be to our mutual benefit. Looking to the future, it is also clear that there will be more interaction between the RN and RCN, and that we should be starting discussions and building upon our relationships at all levels to facilitate shared success.

Strategic Intent

The UK's 2021 Defence Command Paper, Defence in a competitive age, makes clear that:

> …partnerships with Canada, Australia and New Zealand will be at the heart of our tilt to the Indo-Pacific as we work to support them to tackle the security challenges in the region. The joint development with Australia and Canada of our Anti-Submarine Warfare capability through the Type 26 and Hunter class frigate programmes [and Canadian Surface Combatant (CSC)], is just one example of the benefits that deep collaboration can bring.[1]

This statement aligns well with Canada's 2017 Defence Policy, *Strong, Secure, Engaged*:

> Foremost among these relationships [with Europe] is that which Canada shares with the United Kingdom, with whom Canada already enjoys deep and vibrant defence ties rooted in history, founded on shared values, and anchored by close cooperation across the defence enterprise.[2]

There is clear support at the highest levels for collaboration between our two navies, and a recognition that the organizations will become closer over the coming years.

Close Working Relationships

The RCN and RN technical communities have close working relationships in many areas already, and the following provide some examples of this:

- **Training.** Junior RCN Marine System Engineering Officers (MSEOs) complete the Systems Engineering and Management Course (SEMC) at HMS *Sultan* in Gosport, England.
- **Engineering Support.** Repair work aboard HMS *Queen Elizabeth* was conducted by the RCN's Fleet Maintenance Facility Cape Scott (FMFCS) in Halifax, Nova Scotia, in September 2019,[3] during a visit to Canada.
- **Obsolescence Management.** A visit by representatives from the Maritime Surface Combatant (*Halifax* class) project team in Maritime Equipment Program Management (MEPM) to the Frigates project team within Defence Equipment & Support (DE&S) in the UK assisted through providing the opportunity to share knowledge and experience.
- **Exchange Posts.** There are nine exchange positions (4 RN; 5 RCN) — currently all at the rank of Lieutenant Commander — for engineers to work within the other navy (see Table 1). There is also an RN warfare officer position within the RCN's Director Navy Innovation area. These provide a fascinating opportunity to see how another organization goes about managing similar challenges, and to bring a different set of experiences and alternative

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1. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/974661/CP411_-Defence_Command_Plan.pdf, para 5.9, p29
2. http://dgpaapp.forces.gc.ca/en/canada-defence-policy/docs/canada-defence-policy-report.pdf, p 90
3. https://www.cntha.ca/static/documents/mej/mej-92.pdf, Maritime Engineering Journal, Issue 92, Spring 2020, p21

perspective to the table. They also provide the opportunity to live in another country and meet some great people.

Shared Challenges

It is fascinating to have had the opportunity to work within another organization and understand the issues that are being faced; the following provide a few examples where I have seen the RN and RCN facing similar challenges:

- **Managing Aging Frigates.** Both the RN's Type 23 and the RCN's *Halifax*-class frigates are expected to operate beyond their original design lives. This brings common challenges and the opportunity for information sharing between the two organizations. A recent innovation in Canada has been the conduct of "Intermediate Dockings" (docking the ship during the operational cycle) to allow the completion of detailed surveys prior to major docked maintenance periods, thus enabling a better understanding of materiel state to improve work period planning. The RCN is currently in the process of bringing the *Halifax* class into class with Lloyds Register; a process that the RN underwent with the Type 23 class.
- **Personnel.** Both the RN and RCN have faced challenges with maintaining the required number of naval personnel in some trades, especially at the senior non-commissioned officer (NCO) level.
- **Cumulative Risk Management.** Having worked within the RN's Operating Safety Group and seen the introduction of the Delivery Duty Holder for the surface fleet as a head of department at sea, it has been interesting to see how the RCN manages technical risks. With an organization working across four time zones, the coastal "Formation Technical Authorities (FTA)" don't have a direct equivalent in the RN. The FTAs provide the coastal expertise, and capacity for the management of technical risks. Both navies still face the challenge of building an understanding of the level of cumulative risk on sailing — across personnel, training, equipment and other areas — which could potentially be an area for future collaboration.

Shared Opportunities

Linked to the points above, the following provide my thoughts on some areas where we could be considering further technical collaboration between the RN and RCN:

- **Type 26/CSC.** The obvious and major shared opportunity for collaboration and knowledge sharing between the RN and RCN is in the Type 26 Global Combat Ship and Canadian Surface Combatant classes as these ships are brought into service. There are currently exchange officers within the T26 and CSC teams, as shown in Table 1. Although there will be differences between the RN, RCN and Royal Austra-

Table 1: List of RN – RCN Engineer Exchange Jobs

	Position Title	Organization	City	Rank	Occupation/ Sub-Branch
RCN Exchange jobs in the UK	Type 26 Requirements Manager	Navy Command Headquarters	Bristol	LCdr	MS ENG
	Above Water Vulnerability Officer	Submarine Delivery Agency – Naval Authority Group	Bristol	LCdr	MS ENG
	Deputy Training Officer	Royal Navy School of Marine Engineering, HMS SULTAN	Gosport	LCdr	MS ENG
	Canadian Surface Combatant Marine System Design Liaison	Type 26 Project	Glasgow	LCdr	MS ENG
	Canadian Surface Combatant Combat System Design Liaison	Type 26 Project	Glasgow	LCdr	NCS ENG
RN Exchange jobs in Canada	Senior Staff Officer Materiel Sustainment Plan	Canadian Fleet Pacific	Victoria, BC	Lt Cdr	MEGS
	Naval Architecture Officer	Maritime Forces Pacific Fleet Maintenance Facility	Victoria, BC	Lt Cdr RCNC	SDA or DE&S Constructor
	Marine Systems Manager	Assistant Deputy Minister (Materiel) – PMO Canadian Surface Combatant	Ottawa, ON	Lt Cdr	MEGS
	CH-149 Cormorant Mid-Life Upgrade Program	Assistant Deputy Minister (Materiel) – Director General Aerospace Equipment Program Management	Ottawa, ON	Lt Cdr	AE

lian Navy's *Hunter*-class Type 26 ships, there will be opportunities to share knowledge across all Defence Lines of Development (DLODs),[4] especially as the RN increasingly operates in the Indo-Pacific region. At a senior level, the Global Combat Ship User Group (UK, Canada, Australia) will manage much of this interaction.

- **Technical Network.** Across the RN, RCN, DE&S and MEPM organizations, there is a vast technical network of like-minded professionals with experience and knowledge across the full range of challenges we face. It may be that you aren't the only one working on the challenge in front of you; across the Atlantic there may well be another engineer facing a similar problem. I encourage you to reach out and make contact — the best place to start is via one of the RN/RCN exchange officers (or someone who has previously worked in one of these roles) who will be able to point you in the right direction and establish communication through their connections.
- **Information Sharing.** The Canadian *Maritime Engineering Journal*[5] and some previous issues of the UK *The Naval Engineer*[6] are available online — take a look, you might find a different perspective on some familiar topics. The COVID-19 pandemic has demonstrated that there is potential for more opportunities; could we consider greater sharing of knowledge through inviting RN/RCN attendees to the other navy's virtual conferences and technical seminars?
- **Operational Engineering.** In Spring 2021, both Standing NATO Maritime Group One (SNMG 1) and CTF 150 (Maritime Security Operations in the Red Sea, Gulf of Aden, Gulf of Oman and Indian Ocean) were commanded by RCN commodores with HMCS *Halifax* the SNMG 1 flagship. The RN regularly operates with the RCN at sea — with opportunities to work with our opposite numbers in the technical community.
- **Interoperability in the Indo-Asia Pacific.** The UK's 2021 defence policy makes a clear commitment to furthering interoperability and burden-sharing across the world, including in the Indo-Pacific.[7] The deployment of the UK's Carrier Strike Group (CSG) to the Indo-Pacific region in 2021 is a clear indicator of the direction of travel and increased opportunities for RCN Maritime Forces Pacific assets to operate with UK forces in this region.

What does this mean for you?

The examples cited above are intended to spark your interest in identifying possible areas for closer collaboration between the RCN and RN technical communities. As set out in both Canadian and UK defence policy, the next decade will see our organizations working more closely together — both in engineering support and on operations. I encourage you to look for opportunities to reach out to your opposite number and have a look at whether you might be suited to one of the exchange jobs listed here, or with another navy.

It has been a great privilege to work within the RCN and experience life in a different country, especially one as welcoming as Canada. I have returned home with a new perspective on some familiar challenges, and optimism that there are some excellent sailors and civilians working on the solutions to these issues on both sides of the Atlantic.

Marine Engineer Officer Lt Cdr Francis Griffiths joined the Royal Navy in 2001, and served two years on exchange with the RCN as Senior Staff Officer Materiel Sustainment Program within Fleet Engineering Readiness at Canadian Fleet Pacific Headquarters in Esquimalt, British Columbia. Upon his return to the UK last August, he took up new duties as a Marine Engineer "Sea Riding Office" with Fleet Operational Sea Training in Plymouth.

4. Training, Equipment, Personnel, Information, Doctrine & Concepts, Organization, Infrastructure and Logistics
5. https://www.canada.ca/en/department-national-defence/corporate/reports-publications/maritime-engineering-journal.html
6. https://www.royalnavy.mod.uk/useful-resources-and-information/the-naval-engineer
7. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/974661/CP411_-Defence_Command_Plan.pdf, para 3.6, p12

FEATURE ARTICLE

Engineering Readiness: The Key to Mission Success on Op Caribbe

By Lt(N) Kevin Hunt and PO1 Phillipe Kelley

During the summer of 2021, HMCS *Shawinigan* (MM-704) was deployed to the Caribbean Basin in support of Operation Caribbe — Canada's ongoing 16-year contribution to US-led counter-narcotics operations in the eastern Pacific Ocean and Caribbean Sea.

Our mission, which was to work as part of a US-led international coalition force in disrupting the flow of illicit drugs into North America, met with unparalleled success for an RCN minor war vessel. Over a period of just ten days in July, *Shawinigan* conducted two intercepts of drug-running vessels, assisted a coalition ship in a joint intercept, and pursued yet another vessel that led to its cargo being jettisoned. In all, *Shawinigan* chased down four go-fast vessels, seizing 2,800 kgs of cocaine worth approximately US$70 million. What makes this achievement even more impressive is that the ship was alongside in Aruba for four of those ten days on a scheduled port visit.

The interdictions made such a significant impact that, before returning home to Halifax, *Shawinigan* was invited to participate in the United States Coast Guard's (USCG) largest-ever drug offload ceremony at Port Everglades, Florida on Aug. 5.[1] In a first for a Maritime Coastal Defence Vessel (MCDV), USCG Atlantic Area Commander Vice-Admiral Steven D. Poulin presented *Shawinigan* with four Snowflake decals, representing our four successful drug busts. The coveted symbols are now proudly displayed on the ship's bridge wings.

Since 2006, Op Caribbe has committed Canadian ships and maritime patrol aircraft (MPA) on a rotational basis to this important activity, executed under the operational control of Joint Interagency Task Force South (JIATFS) based out of Naval Air Station Key West, Florida. Since 2010, Law Enforcement Detachment (LEDET) teams from the USCG have operated from aboard Canadian ships. With the assistance of coalition intelligence reports and MPA assets, the ships deployed on Op Caribbe are positioned to detect, track and chase vessels of interest until such point as they can be boarded by members of the LEDET. It is an effective partnership, especially when all units are functioning up to their full capability.

USCG Atlantic Area Commander Vice-Admiral Steven D. Poulin presents *Shawinigan* Commanding Officer Cdr Bill Sanson with Snowflake decals, representing the ship's four successful drug interdictions during Op Caribbe.

Shawinigan's demonstrated ability to fight well above its weight class compared to other vessels in the region was, arguably, due in large part to the ship's reliable engineering state. In this co-authored article, developed by *Shawinigan*'s engineering officer and chief engineer, we will outline how the ship's pre-deployment engineering readiness program played a critical role in achieving mission success.

Deployment Overview

From June 9 to Aug. 3, 2021, *Shawinigan* patrolled the central and eastern Caribbean with its embarked LEDET team, responding to reports of suspected narcotic movement from JIATFS, and also participated in Exercise Tradewinds off the coast of Guyana from June 12 to 26. It was that span of ten days between July 12 and 21, however, that made the deployment both memorable and noteworthy. In conjunction with the US Navy, USCG, and maritime patrol aircraft of various nationalities, *Shawinigan* either led or contributed to the interdiction of four narcotics shipments that won the ship its Snowflake honours.

1. https://mapleleafnavy.com/hmcs-shawinigan-in-port-everglades-for-massive-narcotics-offload/

Since a ship deployed on Op Caribbe is unlikely to encounter a go-fast loaded with narcotics simply by chance, it is best positioned inside a patrol box, supported by force intelligence and MPA coverage. The longer a ship is able to remain on station, the greater the likelihood it will have opportunity to engage in an interdiction operation, which of course depends on ensuring all mission-critical systems are available to the command. Responsibility for this falls to the engineering department, whose ability to maximize a ship's time in its patrol box is really the first step toward ensuring mission success.

MCDVs on previous Op Caribbe deployments have regularly reported technical difficulties that significantly reduced their operational capability, including faults with electrical generation, propulsion, climate control, and communications — some of which forced the ship to return to port for repairs. But not once during *Shawinigan*'s deployment did a technical issue cause the ship to cut short an operational patrol, nor remain in port longer than our scheduled visit. In fact, after departing Miami and commencing patrols on June 10, *Shawinigan* did not release a single operational deficiency (OPDEF) message until July 5, and that was for a defect that was rectified within 24 hours using parts held on board.

For the entire ten weeks of our deployment, the engineering department corrected faults as they arose, taking immense pride in our ability to minimize the impact of any defects on operations. The fact that the ship was able to maintain technical readiness throughout the deployment was a great boost to morale, and allowed *Shawinigan*'s mission-focused crew to settle into a smooth operational tempo as we chased down the bad guys. The level of our success is now symbolized for all to see on our bridge wings, but the story of how we achieved this actually began with our pre-deployment preparations starting eight months before we sailed from Halifax.

The Path to Engineering Readiness

In October 2020, *Shawinigan* became the first East Coast MCDV to employ a full-time engineering officer (EO) as part of the Naval Technical Officer (NTO) Lieutenant-Commander Recovery Initiative. The initiative is designed to create additional Head of Department opportunities at sea and ashore to expedite progression into more senior rank positions. In addition to the two-way benefits of having an EO aboard ship with respect to divisional duties, leadership and training, the EO position was helpful in other ways during *Shawinigan*'s long- and short-term deployment preparations, particularly in liaising with various shore authorities.

Admittedly, our ship had something of a head start in terms of preparedness when *Shawinigan*'s early 2021 deployment was cancelled. The ship and crew were already primed for an international deployment six months ahead of Op Caribbe, and the additional months gave us valuable time to conduct further crew integration training and system familiarization to refine our skills and procedures. Before heading south, we also took the ship to sea in the vicinity of Halifax to verify our systems. We used our time well.

In the months leading up to our departure for Op Caribbe, we meticulously reviewed the lessons learned from previously deployed MCDVs on both coasts. A recurring theme was an apparent lack of engineering readiness on departure, which led to technical difficulties and immediate operational impact on deployment. For example, defective and inoperable communication systems in some ships led to reduced connectivity with JIATFS, thus curtailing their availability to participate in operations. How frustrating that must have been. In fact, failures with external communications, and with the air-handling units (AHUs) needed to keep equipment and crew areas cool in the extreme hot conditions, were identified as common

(Continues next page...)

Pre-deployment preparations throughout the spring meant that *Shawinigan* was in a prime engineering state prior to departure for Op Caribbe.

denominators in limiting ships' ability to remain at sea and on patrol. Defective AHUs sometimes forced ships alongside for lengthy and costly repairs — all time spent away from the routes where narcotics were being moved.

Knowing that COVID-19 pandemic precautions would be necessary throughout *Shawinigan*'s deployment, we understood that the possibility of a Technical Assistance Visit (TAV), or the availability of in-service support contractors (ISSC) while in theatre would be severely limited. To mitigate this, we ordered additional spare parts, and arranged supplemental training opportunities to ensure that ship's staff were fully conversant in common faults, troubleshooting, and basic repair work, particularly on the AHUs.

Maintenance on the starboard lube oil system led to full-speed and manoeuvring trials in Bedford Basin, further confirming system functionality three weeks before *Shawinigan* was due to sail on mission-oriented work-ups. Residual connectivity difficulties with the ship's Maritime Satellite Communications Upgrade (MSCU) system warranted investigation by Fleet Maintenance Facility Cape Scott (FMFCS) in the final weeks before departure, which included the replacement of components and subsequent data analysis to ensure system functionality.

Standard practice is to thoroughly trial and verify all systems correct as part of deployment preparations. The timely installation of mission-fit equipment not only gives ship's staff adequate time to do this properly, it also gives operators and technicians alike time to use the equipment and develop a familiarity with it that is precious for troubleshooting. The timing of our mission-fit equipment installation in May 2021, in conjunction with a mandatory quarantine period before departure, complicated our deployment preparations to a point where non-*Shawinigan* crew were overseeing final installations and accepting system status. Not an ideal situation. Still, our pre-deployment sailings and follow-on work requests throughout the spring meant that *Shawinigan* was in a prime engineering state prior to our departure for Op Caribbe on June 2.

Key Systems

It was the continuous availability of three key system suites that ultimately allowed *Shawinigan* to remain mission-ready, and capable of supporting JIATFS throughout the summer of 2021:

1. Propulsion Plant: An MCDV's four diesel-alternators (DA) power two propulsion motors. Since the ship's maximum speed at any one time is dependent on the number of DAs available, the maintenance and engineering readiness of these units is critical to the ship's operational capability. With the exception of an 18-hour period in early July when one DA was offline for troubleshooting and repairs, *Shawinigan* had full power available at a moment's notice throughout our time on deployment.

The readiness of the propulsion plant enabled the pursuit of targets of interest (TOIs) when tasked by JIATFS. Not only was *Shawinigan* setting a standard of propulsion readiness through *preventive* maintenance, but through *corrective* maintenance as well. On one occasion when *Shawinigan* was proceeding at full speed to intercept a TOI, our no. 1 DA suffered a fuel leak and was briefly unavailable. Within an hour, the engineering team had completed repairs and the DA was back online, enabling *Shawinigan* to resume the chase at full speed.

2. External Communications: MCDVs deploying on Op Caribbe are augmented with both the Multi Lateral Enduring Contingency (MLEC) chat for data exchange with JIATFS, and PRC-117 for secure voice communications with JIATFS and aircraft. Being mission-fit equipment, these systems are usually installed shortly before the ship's departure. Since other MCDVs reported having constant difficulties with these systems, we made it one of our deployment preparation priorities to thoroughly trial and familiarize ourselves with the PRC-117, and to also run full functionality tests on both the MSCU and MLEC.

Unfortunately, a lack of PRC-117 equipment in the fleet resulted in installation delays well into the crew's quarantine period. Although this left little time for the crew to fully familiarize themselves with this equipment and develop troubleshooting strategies before sailing, *Shawinigan* was able to maintain connectivity throughout our time in theatre thanks to the hard work of the personnel on board, and to the excellent remote assistance from support teams ashore.

With MSCU, MLEC, and PRC-117 continuously available, the ship received the daily strategy messages and intelligence reports we needed for setting up in our patrol box within MPA coverage. Once in pursuit of a TOI, connectivity with the MPA over PRC-117 was critical in vectoring both *Shawinigan* and our rigid-hull inflatable boat (RHIB) toward the evading go-fast, especially when high seas made visual and radar detection near-impossible.

3. Small Boats: *Shawinigan* departed Halifax with two RHIBs and one Zodiac, providing what we thought would be adequate redundancy for drug interdiction operations. However, we faced defects with both RHIBs, which would normally have sidelined them either until spare parts arrived, or the ship returned home, mirroring the experiences of other MCDVs. With their troubleshooting mindset, the ship's engineering department turned to and conducted corrective maintenance on the outboard engines and steering columns, at one point managing the onboard resources well enough to make one operational RHIB to allow *Shawinigan* to remain available for a tasking. The fact that the two RHIBs were fitted with different makes of outboard engines was a limiting factor, in that parts from one engine could not be used to effect repairs on the other.

If it had not been for our initial high level of engineering readiness, and the quality of the interdepartmental work taken on by the engineering department to keep the ship's propulsion system, external comms and small boats operational while we were at sea, *Shawinigan* could have faced significant technical deficiencies that would have limited the ship's ability to conduct interdiction operations.

The Crew Effort

There's no doubt that *Shawinigan*'s crew was ready for Op Caribbe because we were prepared. Each problem that arose was met with gumption and vigour, and the family-like atmosphere fostered positive attitudes and a no-fail approach. Unfortunately, the history of MCDVs coming home from Op Caribbe without intercepts had introduced a discouraging note among crews, so in the months leading up to our deployment we made it our mission to create and maintain a positive mindset for ourselves.

We were meticulous in our deployment preparations, reviewing those hard-won lessons learned from previous MCDV Caribbe deployments, and formulating a plan to ensure ship-wide preparedness and readiness. We worked hard to ensure that *Shawinigan* would not have to report the same list of deficiencies and engineering troubles that dogged other ships, and that we would make a strong impact in theatre.

One example of this was our approach with the problematic AHU that supplies cool air to the operational spaces. Thanks again to the lessons that were learned and passed along by other MCDV units, we reviewed the air-conditioning system's warm-weather configuration to develop a thorough understanding of the system layout and valve configuration. We then took things a step farther by organizing in-house training from the AHU's contractor to gain a more in-depth understanding of the system's capabilities, common faults and corrective maintenance.

As part of our deployment preparations, we also took the precaution of procuring a number of standalone air-conditioning units and dehumidifiers, which aided greatly in maintaining a comfortable environment beyond the operational spaces, including cabins and passageways. Despite the hot and humid conditions of the Caribbean summer, our strict airlock procedures and limited use of doors to the outside meant that *Shawinigan* was never without air conditioning, thus ensuring that equipment and personnel could operate at their full potential.

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The engineering department took pride in the ship's machinery plant and other onboard systems, and the team's technical abilities were highlighted by how few operational deficiency messages were released throughout the deployment. Going a month without an OPDEF was a clear testament to the department's troubleshooting and repair capabilities. The complementary knowledge base and engineering experience of our team members, gained through previous deployments and various academic and technical backgrounds, made us feel we were capable of handling any defect that cropped up.

By the deployment's conclusion, our embarked LEDET team said they had never operated from a ship where the crew was more committed to readiness. It was another much-appreciated validation of the hard effort we had put in during our pre-deployment phase.

Recommendations

The pursuit of operational success determines how you allocate time and resources, both before and during a deployment. There is no doubt that *Shawinigan* achieved mission success in the summer of 2021, and so the principles noted above should be a model to build upon by future crews and shore authorities. There is a cost to engineering readiness, but it is one that should be weighed against the value of the upcoming operation. A ship's company that is supported at all levels will have the best chance for achieving mission success.

The timely installation of mission-fit equipment, including trials and crew training well before departing home port should be a priority. Giving crews time to develop operating procedures and troubleshooting skills while they still have close access to dockyard FMF and Maritime Operations Group support staff will be rewarded many times over once the ship is deployed. Investment in self-sufficiency will reduce the requirement for in-service support in theatre, and minimize potential equipment-related delays alongside.

The ability to keep a ship on patrol for months at full operational capacity will become a challenge as ships get older, but it is imperative that the propulsion and electrical systems, along with the multitude of support systems needed to keep ship and crew safe and effective be kept up to specification. Increased capability, including infrared surveillance and more agile small boats would increase the likelihood of success on Op Caribbe, and also reduce our dependence on other countries' assets.

As we found for ourselves, the engineering state of the ship can only go so far. At that point, it is up to the ship's leadership to eliminate complacency, and foster a can-do attitude through a vigorous readiness program involving the entire crew.

Conclusion

Compared to the larger, faster and more warfare-oriented ships deployed to the region in the summer of 2021, *Shawinigan* punched well above its weight class in drug-interdiction operations, thereby setting a new standard for MCDVs deploying on Op Caribbe. Our mission success rested on meticulous preparations and supreme engineering readiness, particularly in regards to the propulsion plant, external communication systems, and small boat maintenance.

The engineering department played a major role in boosting crew morale, primarily due to the 24/7 readiness of all on-board systems. Any sense of complacency quickly evaporated following the first drug intercept, with the realization that the combination of engineering readiness and crew preparedness could actually make a difference. With the ship always ready to respond from a materiel standpoint, every additional vessel we intercepted raised the crew's confidence in the ship's capabilities. Preparation and readiness, supported by the steadfast dedication of the crew, combined to form an operational capability that delivered when it counted most.

Lt(N) Kevin Hunt and PO1 Phillipe Kelley are the Engineering Officer and Chief Engineer, respectively, aboard HMCS Shawinigan.

FEATURE ARTICLE

Naval Galvanic Corrosion Awareness

By Anthony Fakhry and Gilles Maranda

Halifax-class ship support and maintenance are essential to ensure the Royal Canadian Navy (RCN) remains fit for purpose, environmentally compliant, and safe. The aging of the fleet and the continued degradation of hull structures and equipment due to corrosion have been an ever-increasing threat to maintenance budgets and operational availability. Corrosion repair of deteriorated external parts and internal spaces is expensive and time-consuming. As a result, the RCN requested that the National Research Council of Canada (NRC) conduct a corrosion condition assessment of *Halifax*-class frigates, and provide recommendations to reduce the overall corrosion of the ships in future.

A total of five frigates were examined — two at the RCN naval dockyard in Esquimalt, BC, and three at the RCN naval dockyard in Halifax, NS. The assessment of the following ships was performed during May and October 2018 while they were at different stages of repair:

- HMCS *Montreal* and *Toronto* before entering docking work period (DWP);
- HMCS *Winnipeg* had entered DWP;
- HMCS *Fredericton* was partially through its DWP; and
- HMCS *Calgary* had completed its DWP and returned to service.

A visual examination of all accessible areas was performed on each ship. After investigation, inappropriate choice of materials was deemed to be the most contributing corrosion factor, along with other factors such as ship design issues, lack of training, inadequate maintenance, and operating conditions.

RCN ships face multiple types of corrosion deterioration, one of which is galvanic corrosion — an electrochemical reaction between two dissimilar metals. With an optimal material selection, proper installation and effective protection, overall ship maintenance costs can be reduced and failures due to corrosion can be minimized.

For over a century, different types of steel have been extensively used in the shipbuilding and marine industries. Due to its relatively high mechanical properties, structural carbon steel (mild steel) forms the integral structure and parts of the *Halifax*-class frigates. Although materials selection is conducted during a ship's design phase, some materials are altered while in-service through deviations and/or engineering changes. With the deterioration of some internal mild steel structures as a result of corrosion, replacing corroded mild steel parts with stainless steel has become a somewhat go-to maintenance practice. If not properly designed and installed, the use of incompatible metals in contact with each other, such as mild steel and stainless steel, could accelerate the corrosion of parts of a system and their surroundings. Consequently, the application of best practices in corrosion prevention becomes key in combating ship corrosion.

Galvanic Corrosion Background

Galvanic corrosion of ship's structure and various fitted equipment due to the use of incompatible metals has been commonly observed during recent visits on board Canadian frigates. As such, knowledge and awareness have become the first steps in abating some of the corrosion damage.

Galvanic corrosion occurs when dissimilar metals are in electrical contact while immersed in a conductive medium, namely an electrolyte such as sea water. Each metal has an electrical potential that indicates its ability to lose or gain electrons. Some are commonly referred to as noble metals, i.e., more stable, while others are less noble and therefore less stable. In addition to being better at holding onto their electrons, noble metals tend to take electrons from less stable metals. The galvanic series chart[1] in Figure 1 depicts the potential range of different metals in sea water, with the noblest metals being at the bottom of the chart.

For galvanic corrosion to occur through what is referred to as a galvanic couple, four conditions must be present simultaneously:

1. a metal that will act as the anode;
2. a different metal with a different electrical potential that acts as the cathode;

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1. Specialty steel industry of North America (SSINA), *Galvanic Corrosion*, Consulted on December 15th, 2019. https://www.ssina.com/education/corrosion/galvanic-corrosion/

3. a conductive path between the anode and the cathode (usually a direct contact between the two metals); and
4. a conductive media: the electrolyte.

If any one of these conditions does not exist, galvanic corrosion will not occur. In a galvanic couple, a current flowing between the cathode and the anode leads to corrosion in only one of the metals, the anode. The farther apart two metals are on the chart in Figure 1, the more likely it is that corrosion will occur if they are joined together.

Corrosion Factors

Figure 2 depicts how galvanic corrosion for a given couple can be complex to determine, since it involves geometric factors in addition to the material and environmental factors. The actual polarity of a metal is tied to metallurgical factors such as its surface condition and any heat treatment[2]. Two of the main factors affecting corrosion rate and metal degradation are:

1. The surface ratio between dissimilar metals; and
2. The circuit resistance.

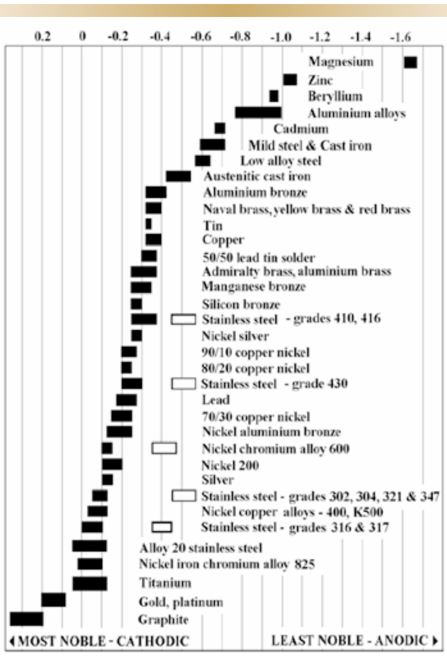

Figure 1. Galvanic Series Chart in Sea Water [4]

The relative surface area of dissimilar metals in contact with one another is an important amplifying factor for corrosion reactions. The effect of a certain amount of current concentrated on a small metallic area is much greater than if it were dissipated over a larger area. In other words, the least favorable ratio is a large cathode connected to a small anode, often leading to accelerated corrosion of the anode. When it comes to anticipating corrosion damage, the surface ratio between dissimilar metals is more important than the magnitude of the potential gradient.

On the other hand, the increase of a circuit's resistance decreases the current rate between metals. Corrosion reactions can then be decelerated or precluded by isolating the circuit with coatings, or by adding a physical non-conductive separation between the metals.

The Role of Electrolyte

During high sea states and storms, upper decks are constantly wetted by sea water, rain, or other electrolytes. Sea water has a particularly high conductivity due to the high concentration of dissolved salt. The electrolyte's ability to conduct electricity in the presence of an electric potential is a key enabler of corrosion reactions. Similarly, sea air acts as an electrolyte with the salt particle concentration in humid air contributing to the atmospheric corrosion of steel.

Mild Steel Compatibility with Stainless Steel

Galvanic reactions between stainless steel and mild steel stem from the potential difference between the two metals. Stainless steel, when in passive phase, acts as the cathode while the hull's mild steel becomes the anode. When the threshold for galvanic corrosion reaction is met, meaning when all four conditions previously mentioned are present simultaneously, stainless-steel components are unaffected while the mild steel components corrode. The material compatibility chart[3] in Figure 3 acts as a visual guide in assessing the potential corrosion risk of metals when joined together. To identify susceptibility to galvanic action, one has to choose an anode metal from the vertical column and verify the crossing zone with a cathode from the horizontal column. Carbon steel and stainless steel, due to their potential difference, meet in a red zone area of the chart, a zone indicating these combinations of materials should be used with caution or avoided.

2. X. G. Zhang, *Galvanic Corrosion*, Teck Metals Ltd., Mississauga, Ontario, Canada https://www.azoresuperyachtservices.pt/images/downloads/MAINTENANCE/GALVANIC%20CORROSION/Galvanic%20Corrosion%20-%20X.G.%20Zhang.pdf
3. Architect's Blog, *Galvanic Action Corrosion Prevention*, Nicholas Buccalo, June 14, 2017. http://www.simpletwig.com/blog/galvanic-action-corrosion-prevention/

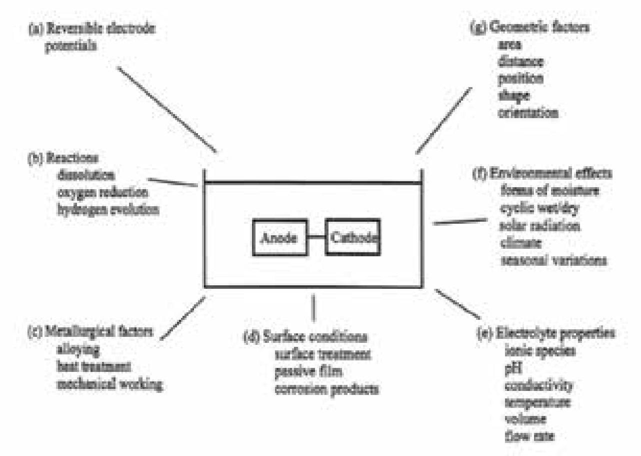

Figure 2. Factors affecting corrosion reactions. [9]

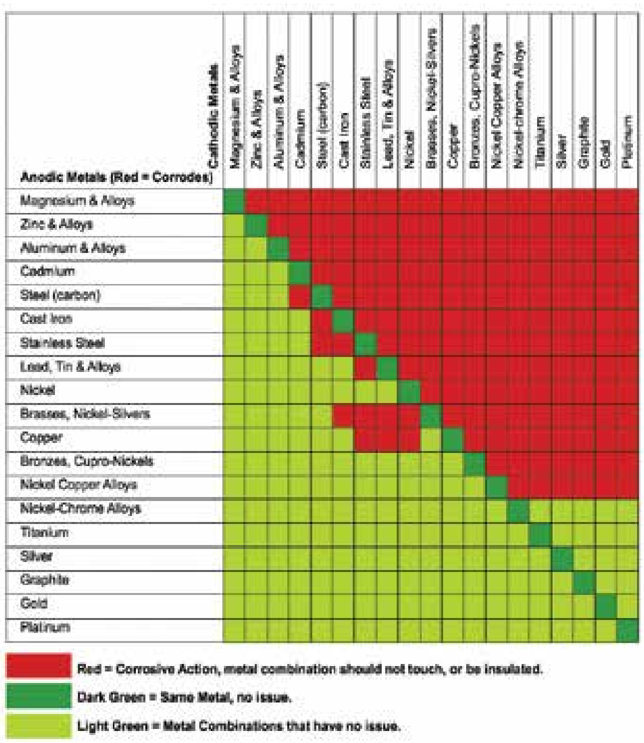

Figure 3. Material Compatibility Chart [5]

Areas Exposed to the Weather

Stainless Steel Cable Transits

The annual cost of corrosion repair on naval ships is increasing exponentially due to aging and exposure to the harsh sea environment. During adverse weather conditions, the upper decks are susceptible to impact damage and scraping, which often leads to corrosion of exposed metal surfaces. In 2011, due to corrosion failure of mild steel pipes and cable penetration transits, the use of stainless steel for exterior transits including multi-cable transits, single-cable transits and deck sleeves was permitted.

Photo by NRC

Figure 4. An uncoated stainless-steel sleeve welded to the mild-steel deck of a *Halifax*-class frigate.

Since then, stainless-steel frames have been welded to the carbon-steel decks and bulkheads. Based on a calculated risk approach, corrosion of the parent material (i.e., the carbon-steel decks and bulkheads) was anticipated and minimized by implementing clear instructions to coat the transits, and by ensuring double-sided welds. Still, protective coatings can often get damaged or have imperfections upon application, thus increasing the risk of galvanic corrosion. Even though the stainless-steel transits remain intact, recent surveys confirm the presence of corrosion of the carbon-steel decks around the stainless-steel transits.

As depicted in Figure 4, due to its contact with an uncoated stainless-steel sleeve, current flowing through the metals' contact area resulted in local corrosion and perforation of the mild steel of the carbon-steel plates. With the current penetration rate being proportional to the metals' contact area, faster corrosion occurs as the contact area is increased. The corrosion reactions that appear on the deck would eventually end once both metals have reached the same polarization. The application of a protective coating to the stainless-steel sleeve in Figure 4 would have certainly slowed corrosion reactions.

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Labeling Plates

During a visit of HMCS *Winnipeg* and HMCS *Calgary*, metal areas surrounding labeling plates (deck tallies) were frequently found to be heavily corroded. A closer look confirmed the use of labeling plate materials that differ from the decks' mild steel. With constant exposure to sea water and sea air, the parent material is locally corroded along the welded edges. Figure 5 shows examples of galvanic attacks in weather-exposed areas as a result of welding or joining dissimilar metals. Similar events could be avoided by the selection of compatible materials, or the proper isolation of the dissimilar metals.

Areas Internal to the Ship

Machinery and fitted equipment on marine vessels are also susceptible to enhanced corrosion caused by exposure to sea air and sea water:

Galley Appliances

Under the original design, stainless-steel galley appliances are affixed to the ship's deck via mild steel studs. Over time, wash-water exposure and leaky tile flooring provided the perfect setting for galvanic corrosion, which was then accelerated by heat and contamination from the galley's environment. In this instance, the use of a rubber isolating material between the two metals could have prevented contact, and increased the lifespan of the equipment seen in Figure 6.

Grease Traps

Grease traps in the galleys were also found to be corroded, as seen in Figure 7. Understanding the environment in which they function is key to anticipating and preventing further corrosion. Grease traps are designed to intercept the grease from the galley's drain before making its way to the greywater treatment system on board *Halifax*-class ships. They operate in a water-grease fluid environment mixed with food residue and cleaning chemicals. With their rectangular design, residue and particles tend to settle in the corners and bottom of the container, making the cleaning process challenging. Rotten food particles within the trap can also lead to an acidic solution.[4]

Under the ships' original design, grease traps are built with a DuraCoated carbon-steel body. Due to the requirement for repeated maintenance to deal with corrosion, fleet maintenance facilities and technical authorities discussed the possibility of opting for a stainless-steel design. Evidently, with its high corrosion-resistance properties, the stainless-steel trap would last longer. However, opting for this new material would translate into the creation of more critical problems in the surrounding areas. In fact, the mild-steel piping and structure in its vicinity would be prone to accelerated corrosion due to the potential gradient between both metals. To avoid corrosion issues, material options such as polymers could be considered if they meet shock, vibration and fire requirements.

Stainless Steel Toilets

During a separate corrosion survey of HMCS *Regina*, stainless-steel toilets showed minor corrosion around the mounting points. Figure 8 depicts corrosion that appeared to be caused by the use of washers or nuts of dissimilar metal in contact with the stainless-steel bolts and the bowl. While a rubber gasket was added between the steel deck and the bowl during installation to prevent contact between the toilet and the deck, potentially limiting galvanic corrosion, additional corrosion was observed on

Photos by NRC

Figure 5. Dissimilar metal connections on the weather deck of a frigate.

Photo by NRC

Figure 6. A severely corroded galley appliances connection.

4. PM Engineer, *Grease Interceptor*, Sterling Laylock, June 24 2016. https://www.pmengineer.com/articles/92582-tech-topic-grease-interceptors

the outside of the bowl of some toilets that appeared to be the result of the use of corrosive cleaner.

Piping and Equipment Connections

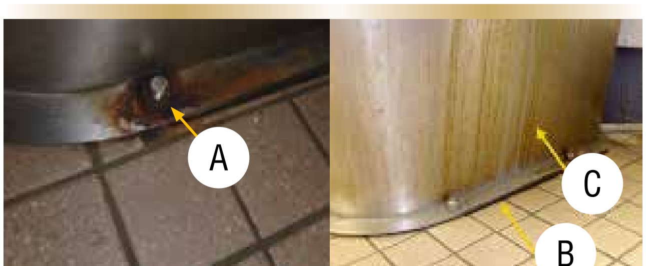
As previously mentioned, galvanic corrosion on board naval ships is not limited to carbon-steel — stainless-steel applications. Figure 9 shows that some reported problems were the result of steel bolts being used on brass fittings at various locations. Joining incompatible materials without complete isolation is the main cause of such galvanic attacks. A simple and economical solution to prevent galvanic reactions from occurring could be achieved by substituting the steel bolts for brass bolts. Systems with piping in bilge areas call for the use of phosphor bronze bolts as a mitigation to corrosion.

Washplace Drains

In some cases, corrosion can be hidden from view in areas where it takes place under a protective coating or covering material. Figure 10 shows that brass drains in particular are common sites of corrosion reactions. During a visit on board HMCS *Winnipeg*, leaky ceramic tiles around brass drains were removed in the ship's heads to validate that corrosion had spread to the surrounding metal, reducing its thickness. Grinding down the area and applying a fresh coat of protective coating is a common maintenance method for minor corrosion repair. Nonetheless, opting for seamless flooring can prevent water ingress to the steel decks.

Photo by NRC

Figure 7. Galley grease trap coating breach and corrosion.



Photos by FMFCB

Figure 8. Corrosion on stainless-steel toilets.

Marine Coatings

Marine coatings act as the ship's first line of defence against corrosion, and their application and maintenance on metallic surfaces should be a continuous process. To achieve long life through maximum adhesion, coatings should be applied over clean surfaces and at the right temperature. Poor adhesion due to the application of coatings over contaminated surfaces creates areas of eventual coating disruption by blistering, reducing the coatings' effectiveness. In general, combatting seawater corrosion through the application of a uniform coating around discontinuous surfaces is challenging; the corrosion concentration at connection points, sharp edges, welds or other discontinuities are commonly observed on RCN frigates. These areas then become focal points for corrosion reactions that could lead to structural failure.

Many corrosion coatings have been developed to protect material from degradation in different types of environments. While it is only a very thin film, the coating separates materials from highly active chlorides and other chemicals present in a ship's environment. A continuous film of even thickness acts as a dielectric barrier, and protects a material's surface from the harsh realities of the marine environment. A marine coating's stringent requirements include, but are not limited to: excellent water resistance, low water-absorption, resistance to ionic passage, resistance to osmosis, high dielectric strength, chemical resistance, weather resistance, high abrasion resistance, and ease of application.[5] Ultimately, a protective coating's performance determines the lifetime of a coated system.

Summary

With a fleet-wide corrosion problem, corrosion awareness and knowledge become essential during material selection, design and maintenance. The application of corrosion prevention and control practices will reduce the through-life cost of naval assets, and ensure they remain mission capable. As such, preventing galvanic corrosion through dissimilar metal isolation, avoiding unfavorable area ratios between anodes and cathodes, continuous application of coatings, selecting compatible materials, and isolating metals from electrolytes will lead to reduced equipment failure rates and increased operational availability.

(Continues next page...)

5. Francis L. Laque. (1975). *Marine corrosion causes and prevention*. New York, John Wiley & Sons

Photo by NRC

Figure 9. The problem with using dissimilar metals at connection interfaces.

Photos by NRC

Figure 10. Hidden washplace drain corrosion where the bronze strainer interacts with the mild-steel decking below the tiles.

Possible solutions

1. Remind first-line maintainers on material compatibility to avoid galvanic corrosion of equipment and piping connection points;
2. Remind second-line and third-line maintenance personnel to ensure material compatibility during maintenance through revised technical specifications; and
3. Increase quality assurance (QA) and quality control (QC) personnel's awareness and verification of material compatibility.

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Gilles Maranda is a Senior Engineer working for the Naval Engineering Test Establishment (NETE), currently supporting DGMEPM/DMEPM MSC/MSC 8-4-2

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Experts

[10] Nafiseh Ebrahimi, Ph.D. P. Eng., Assistant Research Officer, National Research Council Canada, Ottawa, Ontario

Galvanic Corrosion Abatement: Laser Additive Manufacturing for Station Tally Plates

By Lt(N) Christopher Chang
LAM Engineer, Fleet Maintenance Facility Cape Scott

The emergence of laser additive manufacturing (LAM) techniques by the Fleet Maintenance Facilities (FMFs) is helping to address the effects of galvanic corrosion in one specific application aboard RCN ships. The small brass and aluminum tally plates used throughout a ship's structure to identify frame and compartment information are known points of corrosion, and are the subject of an FMF Cape Scott trial to replace them using a variety of 3D-printed plastic polymers.

Tally plates are generally affixed to the ship's structure, although not directly to the steel so as to prevent galvanic corrosion. A painted, mild-steel backing plate is usually inserted as a non-corrosive interface, but over time this barrier can become degraded, allowing contact with the dissimilar bare metal of the tally plate. By replacing the tally with an electrically inert plastic alternative, corrosion at this interface cannot take place. FMFCS is therefore testing a suite of commercially available ABS and PLA thermoplastic polymers to produce interior station tally plates from standardized digital models using a "fused deposition" 3D-printing process.

In addition to addressing the galvanic corrosion issue, 3D-printed polymer tallies do not require metal to be machined, and can be produced wherever a fused-deposition 3D printer exists on board ship or ashore. It is not clear yet whether a single polymer will be a good fit for all interior locations, or even for exposed weather decks. Additional coatings might also be required to improve visibility or durability, but any need to polish these tally plates will be eliminated.

With anywhere from 150 to 200 tally plates per ship, there remains the question of production scalability. While computer modelling has been completed for the majority of the various tallies, the average time to actually produce one ranges from two to five hours, depending on the size of the plate and the material selected. Wider implementation of 3D-printing equipment, and the introduction of bulk printing processes should help alleviate any scalability issues. The FMF trial is also examining how to best adapt the new polymer plates to the old backing mounts.

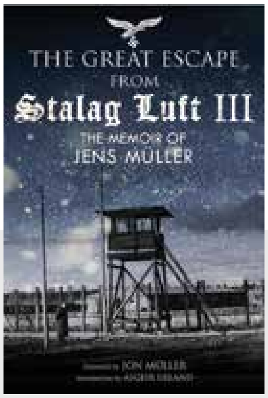
The challenges involved with this trial make for a compelling project, and as we move forward with finding solutions, and determining which commercial polymers and coatings will best fit the various applications, we are well on our way to combating one small area of galvanic corrosion aboard ship.

Photo by Lt(N) Christopher Chang, FMF Cape Scott

FMF Cape Scott is testing a suite of polymers for producing interior station tally plates. The orange tally plate shown here is made of ABS thermoplastic polymer. The grey plate shown being printed on the inside cover of this magazine is made of PLA, a bio-friendly thermoplastic.

BOOKS

Titles of Interest

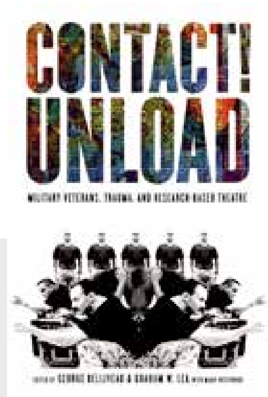


The Great Escape from Stalag Luft III
The Memoir of Jens Müller

By Jens Müller
192 pages; maps, drawings and photos
ISBN-10: 1784384305
US Naval Institute Press (2019)
https://www.usni.org/press/books/great-escape-stalag-luft-iii

Jens Müller was one of only three men who successfully escaped from Stalag Luft III (now in Zagan, Poland) in March 1944 — the break that later became the basis for the famous film, The Great Escape. Together with Per Bergsland, another Norwegian POW, he stowed away on a ship to Sweden where they sought out the British consulate and were flown to the UK. They were eventually sent on to "Little Norway," the Royal Norwegian Air Force training camp at Toronto Island Airport in Ontario, Canada.

First published in Norwegian in 1946, this vivid, informative memoir details what life in the camp was like, and how the escapes were planned and executed.



Contact!Unload
Military Veterans, Trauma, and Research-Based Theatre

Edited by George Belliveau and Graham W. Lea *with* Marv Westwood
Series: Studies in Canadian Military History
272 pages; black & white photos, chart
ISBN: 9780774862622; Available also in Paperback, PDF and EPUB
UBC Press (2020); https://www.ubcpress.ca/contactunload

This book is a call to action to responsibly address the sometimes difficult transition many soldiers face when returning to civilian life. It explores the development, performance, and reception of *Contact!Unload*, a play that brings to life the personal stories of veterans returning home from deployment overseas.

The play showcases an arts-based therapeutic approach to dealing with trauma. To bring *Contact!Unload* to life, researchers in theatre and group counselling collaborated with military veterans through a series of workshops to create and perform the play. Based on the lives of military veterans, it depicts ways of overcoming stress injuries encountered during service. This action-based artistic initiative, coupled with a therapeutic program, served as a successful model for military veterans transitioning to civilian life.

This book, which includes the full script of the play, offers academic, artistic, personal, and theoretical perspectives from people directly involved in the performances of *Contact!Unload,* as well as those who witnessed the work as audience members. Both the play and the book serve as a model for using arts-based approaches to mental health care and as a powerful look into the experiences of military veterans.

This innovative volume will appeal to arts-based researchers, clinicians, mental health practitioners, military personnel, and veterans who want to explore alternative, arts-based therapeutic approaches to trauma.

NAVAL TECHNICAL OFFICER AWARDS

2019 Weir Canada Award

Photo by S1 Michael Goluboff, MARPAC Imaging Services

Lt(N) Dave Costigane

Top Marine Systems Engineering Phase VI candidate

With Tony deRosenroll Senior Engineer, Weir Canada, Inc.
Esquimalt Detachment of the Naval Engineering
Test Establishment (NETE)

2020 Weir Canada Award

Photo by Brian McCullough

Lt(N) Alisha McCafferty

Top Marine Systems Engineering Phase VI candidate

With Joël Parent Site Manager, Weir Canada, Inc.
Naval Engineering Test Establishment
(NETE) Montréal

2019 L3 MAPPS Saunders Memorial Award

Lt(N) Alisha McCafferty

Top student, Marine Systems Engineering
Applications Course

Presented remotely by Wendy Allerton
Director, Business Development
L3Harris Maritime International Sector
Integrated Mission Systems

2019 Lockheed Martin Canada Award

Lt(N) Samuel McNicholas

Top Combat Systems Engineering Phase VI candidate

Presented remotely by Simon Hughes
Senior Business Development Manager
Lockheed Martin Canada

NAVAL TECHNICAL OFFICER AWARDS

2019 Mexican Navy Award

Lt(N) François Lemieux

Top student, Naval Combat Systems Engineering Applications Course

Presented on behalf of Arturo Caracas Uribe, Mexican Naval Attaché to Canada

2020 Mexican Navy Award

SLt Chih Wen Hsiao

Top student, Naval Combat Systems Engineering Applications Course

Presented on behalf of Arturo Caracas Uribe, Mexican Naval Attaché to Canada

2020 Naval Association of Canada Shield

SLt Andy Lee

Highest standing, professional achievement and officer-like qualities during Naval Engineering Indoctrination

Presented by Cdr (Ret'd) Al Kennedy

2020 Macdonald Dettwiler & Associates Award

Lt(N) Eric Pitre

Top NTO candidate to achieve Head of Department qualification

Presented by member's unit

Bravo Zulu to all these winners, and watch for more awards in our next issue!

PRESERVING CANADA'S NAVAL TECHNICAL HERITAGE

CNTHA

NEWS (WINTER 2021)

Canadian Naval Technical History Association

Building HMC Ships *Iroquois* and *Huron*

By Captain (Navy) (Ret'd) Don Wilson

In the 1960s, the development of the Royal Canadian Navy's DDH-280 Program had reached a point where the two shipyards that would be building the four tribal-class destroyers could be announced: Marine Industries Limited (MIL) in Sorel-Tracy, Québec was named as lead yard for *Iroquois* (DDH-280) and *Huron* (DDH-281), while Davie Shipbuilding in Lévis, Québec was identified as the follow yard for *Athabaskan* (DDH-282) and *Algonquin* (DDH-283).

LCdr Ron Hahn and I (also a LCdr at the time) were duly identified as the Engineer Officers-Designate for *Iroquois* and *Huron*, respectively, and it would be our responsibility to oversee the building of our respective ships as members of the staff of the Principal Naval Overseer (PNO) Sorel, later 202 Canadian Forces Technical Services Detachment (202 CFTSD).

Construction of *Iroquois* got underway on Jan. 15, 1969; *Huron* would be laid down months later on June 1. As the initial construction units were being fabricated under cover from the weather, keel support blocks for the two hulls were set up outside in the yard adjacent to MIL's marine railway. Once completed, each construction unit was moved out of the shed and welded to the adjoining unit already on the blocks, and in this way the ships gradually began to take shape as the TSD staff monitored the shipbuilder's operations.

The shipyard had implemented a quality management system manual, prepared in the Naval Central Drawing Office in Montréal, and published as QUAL-1-01. The Canadian naval standard was designed to ensure that work proceeded well and progress was documented. The TSD staff was impressed by the fine work being performed by the MIL team, and as the months went by, *Iroquois* and *Huron* really started to look like warships. Many of the ship compartments now contained equipment and systems, including the propulsion engines, gearboxes, flexible couplings, shafting and variable pitch propellers. Electrical and other cabling, and piping, were being installed as the units came together.

The DDH-280 Tribal-class destroyers *Iroquois* (left) and *Huron* under construction at Marine Industries Ltd., Sorel-Tracy, Québec circa 1970.

Once the shafting and propellers were installed, construction reached the point where the hulls needed to be set into the water temporarily to establish the line of shafting and positioning of intermediate bearings. Blocks with wheels were installed under the ships' hulls to allow the two ships to be traversed onto the marine railway cradle to be prepared for the launch. While it was not as glamorous as seeing a ship slide down the ways with banners flying and crowds of dignitaries in attendance, that preliminary launch was quite significant. With the afloat configuration readings for the shafting established, the ships could be pulled from the water for final positioning of the A-brackets and other shaft supports. The ships were eventually launched formally on Nov. 28, 1970 (*Iroquois*) and April 9, 1971 (*Huron*).

In the summer of 1972, after fitting-out, *Iroquois* was ready for alongside trials, followed by contractor sea trials. Marine Industries had engaged Michel Goulet, a merchant master, and retired RCN marine engineer Cdr Gord Smith as the team leaders for the initial alongside set-to-work and subsequent sea trials. As the ships' engineer-designates, Ron Hahn and I were also involved. *Iroquois*' launch and alongside trials

(Continues next page)

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Iroquois fitting-out alongside at the MIL shipyard.

Contractor's Engineer Officer Gordon Smith (right) turns over the machinery system "ignition" key to LCdr Don Wilson, HMCS *Huron*'s Engineer Officer on commissioning.

went very well, following which the ship set sail for contractor sea trials in the early summer, travelling down the St. Lawrence River to the open waters of the Gulf of St. Lawrence. With these trials also successfully completed, *Iroquois* returned to MIL to be prepared for commissioning on July 29, 1972, and then sailed to join the fleet in Halifax.

The same series of events took place for *Huron* and, in due course the ship was commissioned on Dec. 16, 1972. *Huron*'s passage down the St. Lawrence on the way to Halifax was a bit more of a challenge than what *Iroquois* had faced in July, as the river was by this time largely frozen over. An icebreaker accompanied us down river, but when we reached the Quebec Bridge we encountered broken ice more than four metres thick. During our passage from Sorel, the ship's firemain pressure had kept falling off as ice clogged the pump intakes. Needing this water to cool the propulsion system, I dispatched a roving gang of stalwarts that went from one intake to the next, closing the isolating valves and opening the intakes to remove the crushed ice. Keeping the five pump intakes clear kept the gang busy, and someone in the party was heard to suggest the ice could be delivered to the wardroom and galley. We eventually got through at Québec, and the rest of the passage was uneventful. A welcoming committee led by *Iroquois* came out to greet *Huron* on our arrival in Halifax Dockyard.

In addition to their Sea Sparrow missile point-defence role, the DDH-280s were able to provide the RCN with a robust anti-submarine capability, both through the use of fitted ASW sonar equipment and weapons on board ship, and in concert with the deployment of the two embarked Sea King helicopters that carried dipping sonars and ASW torpedoes. Helicopter trials for the new ships would normally have been conducted by *Iroquois* as part of the first-of-class trials, but the ship's commanding officer, Cdr Doc McGillivray, had no previous DDH command experience. Since *Huron*'s CO, Cdr Dick Hitesman, did have prior experience with helicopters as commanding of HMCS *Margaree* (DDH-230), our ship was tapped to conduct post-commissioning helicopter trials.

Not long afterward, *Huron* found itself cruising off the Nova Scotia coast near St. Margaret's Bay with two Sea Kings in the hover, ready to be recovered. One at a time they flew in over the flight deck to be hauled down and secured by the bear trap, then traversed into the twin hangar. A third Sea King then arrived on scene, and this too was hauled down and secured to the flight deck by the bear trap. The purpose of this trial was to confirm that, even with the "barn" full of helicopters, a 280-class DDH could still provide a safe landing deck for a third Sea King. An elated Cdr Hitesman couldn't resist sending a message back to Maritime Command HQ to report there were three helicopters on board *Huron*, and that his cup was truly running over.

As the years passed, the DDH-280s served the RCN very well. All four destroyers underwent a Tribal Class Update and Modernization Program (TRUMP) refit in the late 1990s that saw them fitted with new missile systems, and redesignated as DDGs. By 2017, the last of these remarkable ships had been paid off. My own ship, HMCS *Huron*, was taken out of service in 2000, paid off in 2005, and subsequently sunk as a target ship off the West Coast in 2007.

Captain (N) Don Wilson, P.Eng, CD, RCN (Ret'd) was the Engineer Officer aboard HMCS Huron when the ship commissioned on Dec. 16, 1972.

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